

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

ANNUAL REPORT

1992-93

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[Indian Council of Agricultural Research]
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ABOUT THIS REPORT

This is the Ninth Annual Report of All India Coordinated Research Project on Cashew. The first three Annual Reports pertain to the years 1984-85, 1985-86 and 1986-87 in which the reporting period was 1st July to 30th June of the subsequent year. During 1988, the reporting period was changed to January to December, based on decisions of the Directors/Project Coordinators' Conference of Horticulture Division of ICAR, held at IIHR Bangalore during 08-11 April 1988. However, the ICAR has now decided to bring in an uniformity in the reporting period and once again reporting period is changed to 1st April to 31st March. This report covers the work carried out from 1st April, 1992 to 31st March, 1993.

There are seven Project Centres, four on the East-coast of India (Thargam, West Bengal; Bhubaneswar, Orissa; Bapatla, Andhra Pradesh and Vridhachalam, Tamil Nadu); two on West-coast (Madakkathara, Kerala; Vengurla, Maharashtra) and one in Meidan parts of Karnataka (Chintamani) were implementing the research programmes. There are eighteen research projects belonging to Breeding, Agronomy, Horticulture and Entomology disciplines. The results reported by different centres are presented in this Report.

This report consists of two Chapters, viz., TECHNICAL--consisting of Projectwise Experimental results from different centres and ORGANIZATION--dealing with History, functioning, budgetary provisions, staff and meteorological data. The research publications by different centres are also appended at the end.

DUJTUR 574 202
13 July, 1993.

EVV BHASKARA RAO
PROJECT COORDINATOR

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CHAPTER-I: TECHNICAL

(i)

COORDINATOR'S REPORT

During the Seventh Plan the ongoing All India Co-ordinated Spices & Cashewnut Improvement Project started in 1971 has been bifurcated into two separate projects, one on Cashew and another on Spices. The Coordinator's Cell were located in respective National Research Centres, which were also started during VII Plan. The All India Coordinated Research Project on Cashew has seven centres of which four were started at the inception of AICS & CIP in 1971 (Bapatla, APAU; Anakkayam, KAU; Vengurla, KKV and Vridhachalam, TNAU), one started during V Plan period (Bhubaneswar, OUAT) and two more were added during VI Plan (Jhargram, BCKV and Chintamani, UAS). The budget allocation of the Project for the year 1992-93 is Rs.24.00 lakhs (Rs. 18.00 lakhs ICAR Share). During 1992-93 the expenditure was Rs.23.02 lakhs (Rs.17.26 lakhs ICAR Share). The Project mandate is to increase the production and productivity of cashew through:

- "
- * Evolving high yielding varieties resistant/tolerant to diseases & pests
- * Standardizing agrotechniques for the crop under different agroclimatic conditions
- and
- * Evolving effective pest and disease management practices

In lieu of X Biennial Workshop of the Project, a National Group Discussion of Cashew Research Workers was held at CPCRI, Kasaragod (Kerala) during 30-31 August and 1st September 1991. The technical programmes decided at the Group Discussion were implemented

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by the Centres. Summary of the results of current year are summarized below:

CROP IMPROVEMENT

A total of 859 cashew germplasm accessions (Bapatla-123; Bhubaneswar-76; Chintamani-114; Jhargram-111; Madakkathara-115; Vridhachalam-159 and Vengurla-161) are being maintained and evaluated in different centres. In the germplasm evaluation, the highest yield was recorded by T.No.10/4 (42.0 kg), T.No.228 (41.2 kg) and T.No.71 (31.0 kg) of Bapatla; ME 4/4 (15.95 kg), 4/61 Alengudi (13.19 kg), 3/108 Gubbi (12.75 kg), 1/61 Alengudi (12.35 kg), 5/23 Coondapur (10.30 kg), 8/46 Taliparamba (10.30 kg) and 1/64 Madhuranthekem (6.30 kg) (more than five kg cumulative mean yield/tree) of Chintamani; JGM 56/7 (9.45 kg) and JGM 80/2 (9.04 kg) of Jhargram; and M 26/1 (22.5 kg/tree) and M 15/4 (10.72 kg/tree) of Vridhachalam. During the year a total of 34 new collections (Bapatla-6; Bhubaneswar-5; Jhargram-8 and Madakkathara-15) showing promising characters were added to the germplasm by different centres. From the old germplasm, a total of 214 accessions have been clonally multiplied and planted in the conservation block by Bapatla (92), Chintamani (42) and Vengurla (80)

In the multilocation trial, 18 varieties collected from different centres are being evaluated. Highest yield was obtained from T.No.129 (1.25 kg) at Bapatla; V-4 (2.4 kg) at Bhubaneswar; H 1600 (3.73 kg) at Chintamani; VTH 59/2 (4.24 kg) at Bhubaneswar; M 26/2 (12.8 kg) at Madakkathara and V-5 (6.99 kg) at Vridhachalam.

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Evaluation of F_1 hybrids showed that three hybrids from Bapatla viz., Hy 3/28, Hy 2/16 and Hy 3/39 gave a mean yield of 17.8 to 24.6 kg/tree. Two hybrids from Madakkathara viz., H 1598 and H 1608 were recommended for release by the Kerala State Varietal Release committee.

A hybrid from Vridhachalam, ie., Hy 4 (M 10/4 x E. 4/2-1) gave a mean yield of 6.31 kg/tree; the mean yield of two hybrids from Vengurla (Hy 255 and Hv 336) was 15.25 kg and 12.5 kg, respectively.

CROP MANAGEMENT-- A. AGRONOMY

In NPK trial, application of N (0, 500, 1000 g/plant), P_2O_5 (0, 125, 250g/plant) and K_2O (0, 125, 250g/plant) showed an increase of yield over control and the increase in yield was linear in Bhubaneswar. Application of N 1000 g, P_2O_5 250 g and K_2O 250 g was found to be the best of the treatments. At Jhargram maximum yield was recorded at 300g N, 200g P_2O_5 and 600g K_2O dose of fertilizer application.

Foliar application of urea along with insecticides (2% and 3% urea spray), increased yield at Bapatla and Jhargram. At Madakkathara (3%, 4% and 2% urea spray), Vridhachalam (4% and 3% urea spray) and Vengurla (3% and 4% urea spray) an increase in the yield was recorded.

In the spacing trial, at tenth year of planting, trees planted in 6m x 6m x 6m triangular system gave the highest yield (39.688 kg/block of 25 plants) and the trees planted in 10m x 10m square system gave the minimum yield (25.66 kg/block of four plants) at

(iv)

Jhargram centre.

At Bapatla, standardization of index leaf in cashew has been done. Nitrogen content in the third leaf is significantly higher than that in the fourth leaf. Leaf samples collected before fertilizer application contained relatively low amount of nutrients, which increased upto 60 days after fertilizer application and decreased thereafter. Yield was found to be correlated positively with leaf nutrients concentration of N, P, K, Ca and Mg.

In the cashew based cropping systems, trial at Bapatla, the annual crops suffered due to severe moisture stress; at Vridhachalam, cowpea was found to be a good cover crop; at Vengurla, intercrops like Australian acacia and subabul adversely affected the growth as well as yield of cashew. Eucalyptus and casuarina affected the main crop marginally.

CROP MANAGEMENT-- B. HORTICULTURE

Soft wood grafting was found to be a successful method for vegetative propagation of cashew. Highest percentage of graft success was recorded during December (72.8%), January (73.5%) and February (61.7%) at Bapatla; September (75.0%), August (68.23%) and July (58.0%) at Ehubaneswar; September (60.0%), November (51.1%) and December (48.0%) at Chintamani; July (59.0%), August (67.0%) and September (63.0%) at Jhargram; August (90.9%) and November (67.5%) at Vridhachalam.

Flush grafting was not successful at all the centres. At Vridhachalam, 42 day old scions grafted on 35 day old root stocks gave the highest success (73.5%).

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At Vengurla, 21-40 day old root stocks when grafted with 28-42 day old scions gave the highest success (more than 79.2%).

A good graft success in top working was obtained at Bapatla (60-80%), and Bhubaneswar (60-80%) and the success was low (11.7-25.0%) at Jhargram. At Vridhachalam, the top worked trees have been affected by stem and root borer. At Vengurla centre, five year old top worked trees (10 Nos.) gave a mean yield of 5.25 kg/tree.

Screening of root stocks for dwarfing characters is in progress at Madakkathara and Vengurla.

CROP PROTECTION

Treatment T-5 (spraying of monocrotophos 0.05% during flushing, endosulfan 0.05% during flowering and carbaryl 0.1% during fruiting stage) was found to be superior over other treatments controlling tea mosquito and other pests at Chintamani and Jhargram centres. Whereas, T-4 (spraying of monocrotophos 0.05% at flushing and endosulfan 0.05% at flowering stage) was found to be superior at Vridhachalam and Vengurla in trials on chemical control of cashew pest complex.

In controlling minor pests of cashew such as Myllocerus sp., Hipotima haligramma, Lamida monocusalis, leaf miner, leaf thrips etc., treatment T-5 was found to be effective at Chintamani, Bapatla, Jhargram and Vengurla.

In the trial on control of foliage/inflorescence pests of cashew with neem products, at Bapatla centre

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all the neem products tried performed well and maximum yield was recorded in the treatments sprayed with neem cake extract (5%), followed by neem seed kernel extract (5%) spray. At Vridhachalam, neem seed kernel extract (5%) and neem oil (2%) have recorded minimum tea mosquito damage.

At Bapatla swabbing of neem seed kernel extract (5%), neem cake extract (5%), neem oil (5%) and application of Sevidol 4G on uninfested trunk during April was found to be a good prophylactic control measure against stem and root borer infestation upto 90 days. At Bhubaneswar Kaoline swabbing, neem cake extract (5%) resulted in less infestation. At Jhargram there was absolutely no infestation on the tree treated with HCH (0.2%). The infestation was negligible with neem oil (5%) and neem seed kernel extract (5%). All the treatments were effective at Madakkathara and Vridhachalam.

Bioecology of tea mosquito, leaf miner, leaf and blossom webber, leaf thrips, inflorescence thrips, fruit and nut borer, stem and root borer, shoot tip caterpillar, leaf folder etc. were studied at Bapatla, Bhubaneswar, Chintamani, and Jhargram centres.

Screening of germplasm to locate tolerant/resistant types to major pests of the region have been carried out. At Bapatla, T.No.274L, 286, 244, 232 and 231 were found to be less susceptible to weevils, T.No.232 and 71 to leaf miner, and T.No.228 and 232 to Hipotima haligramma. Less infestation was observed on Type 1608 for shoot tip caterpillar (Bhubaneswar), on accession No.1998, 1600, 1610, H 26, 5/37, 4/48, 1/84 and 9/38 for inflorescence thrips and fruit and

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nut borer (Chintamani), on accession No.H 856, H 1588,
and H 1589 for tea mosquito (Madakkathara), on M 20/4
for shoot and blossom webber (Vridhachalam) and on M
19/1610, 2/15, V-4, M 33/3, M 26/2 and M 44/3 for
shoot tip and inflorescence caterpillar (Vridhachalam).

-x-x-x-x-x-x-x-

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

Gen.1: Germplasm collection, maintenance and description of types

(Bapatla, Bhubaneswar, Chintamani, Jhargram, Madakkathara, Vridhachalam and Vengurla)

The objective of this Project is to evaluate the available germplasm and collection of accessions with desirable characters, such as bold nut, cluster bearing, short flowering duration types and establishment of germplasm conservation blocks with clonal progenies.

BAPATLA

At present there are 123 germplasm collections at Cashew Research Station, Bapatla. Among the 123 germplasm accessions, 92 accessions were multiplied vegetatively and planted in the new orchard area and also supplied to other Research Stations at V.R. Gudem, Aswaraopet, Kaveli and Pandirimamidi.

Scions of Rajahmundry selection were supplied to different Coordinating centres for maintenance and evaluation.

A total of six elite types were collected and planted. The characters of the elite types are given in Table-1.

The yield performance of promising germplasm accessions is given in Table-2. Among the 20 promising germplasm accessions, T.No.10/4 (42.0 kg), T.No.228 (41.2 kg) and T.No.71 (31.0 kg) recorded maximum yields during 1992 showing shelling percentage more than 28.0,

Table-1. Description of cashew types collected(Bapatla)

Sl. No.	Source	No.of ac- cessions collected	Description of types collected
1.	Muttayapalem	2	Cluster bearing habit, bold nut size 10g. Yielding 25-30 kg/tree
2.	Lakshmipuram	1	Bold nut size 14g. Ex- tensive branching, sparse canopy. Yielding 15 kg/tree
3.	Radhayapalem	1	Compact canopy; Early flowering; Large size nut 9g. Yielding 25 kg/ tree
4.	Vengurla		
	(a) Tulas	1	Oil less (non-corrosive) type, bold nut size
	(b) Konkadi	1	Bold nut size 16 g; Sparse branching

Table-2. The yield performance of promising germplasm
accessions (Bapatla)

Sl. No.	Access- ion No.	Yr. of plant- ing	Cumulative yield (1983-92) (kg)	Yield of 1992 (kg)	Mean nut wt. (g)	Shell- ing %
1	T-14	1942	232.8	12.7	5.3	28.0
2	241	1942	358.3	12.5	5.2	27.0
3	232	1942	405.8	13.7	5.0	30.0
4.	71	1942	728.2	31.0	5.0	31.0
5	1(L)	1942	88.5	16.0	5.2	28.0
6	268(A)	1942	93.8	17.0	5.5	28.5
7	274(L)	1942	236.0	26.2	5.0	29.0
8	228	1942	182.5	41.2	5.2	28.0
9	233 (L)	1942	234.5	24.0	5.5	28.0
10	3/10	1962	41.0	4.5	8.2	28.0
11	2/3	1962	121.5	15.8	6.4	27.0
12	3/7	1962	221.2	3.7	7.0	27.0
13	3/1	1962	116.8	9.0	5.1	27.0
14	6/20	1962	167.0	4.2	5.0	26.0

Table (ctd...)

Table-2 (ctd:..)

03

15	4/3	1962	120.0	24.0	5.2	27.0
16	2/4	1962	136.5	15.3	5.5	26.0
17	5/4	1962	120.0	10.5	6.0	25.5
18	8/7	1962	132.5	17.0	5.8	25.5
19	10/4	1962	208.0	42.0	5.2	29.0
20	10/7	1962	140.0	29.0	5.4	30.0

The following released varieties of cashew from different Cashew Research Stations were collected during 1992 and planted to evaluate their performance under agroclimatic conditions of Bapatla.

1. NRCC Selection-1
Selection-2
VTH 711/4 (Brazilian type)
2. Vengurla V-1, V-2, V-3, V-4, V-5 and V-6.
3. Vridhachalam VRI-1 and VRI-2
4. Madakkathara Madakkathara-1
Madakkathara-2
Anakkayam-1

BHUBANESWAR

The germplasm collection block consists of 76 accessions which were planted from 1990 to 1992. The plants are not in the bearing stage.

Five elite types with cluster bearing habit were collected during 1992-93. The description of the elite types are given in Table-3.

Table-3. Description of cashew types collected (Bhubaneswar)

Source.	No. of accessions collected	Description of materials collected
Madhipur, Konark; Puri.	1	Cluster bearing, 10-12 nut/panicle, average nut weight 5.1g with approximate yield 20.0 kg/tree, yellow apple, synchronized, flowering & fruiting.

Table (ctd.....)

Table-3 (ctd...)

Madhipur	2	Cluster bearing, number of nuts/cluster 15-16, average nut weight 3.49 g, yield 30.0 kg/plant
Kunjamath	1	Cluster bearing, yellow apple, number of nuts/cluster 12-15. Nut weight 4.91 g. Average yield 60-65 kg/tree.
Iseneswar, Puri	1	Cluster bearing (8-10 nuts/cluster), nut weight 6.49g average yield 40-45 kg.
Chhatrapur	1	Cluster bearing, number of nuts/cluster 10-12, nut weight 4.5g, average yield 30-35 kg/plant.

The following released varieties of cashew from different Cashew Research Stations were collected and planted to evaluate the performance under agroclimatic conditions of Bhubaneswar.

Name of Research Station	Yr. of planting	Variety
Bapatla (Andhra Pradesh)	1990	BPP-1, 2, 3, 4, 5 & 6
NRC-Cashew, Puttur (Karnataka)	1990	Selection 1 & 2
Vridhachalam (Tamil Nadu)	1990	VRI-1, VRI-2
Jhargram (West Bengal)	1990	Jhargram-1
Bhubaneswar (Orissa)	1990	Bhubaneswar-1
Madakkathara (Kerala)	1991	Anakkayam-1, K-22-1, Madakkathara-1 & 2
Vengurla (Maharashtra)	1990	Vengurla-1, 2, 3 & 4
	1992	Vengurla-6

CHINTAMANI

- | | |
|---|---|
| 1. Date of start of germplasm collection | August 1982 |
| 2. No. of seedling progenies collected | 34 seedling progenies during 1983 |
| 3. No. of accessions multiplied clonally from the original seedling collections | 42, collections were made since 1990, 5 collections already planted. The grafts of remaining accessions are ready for planting. |
| 4. Number of direct clonal collection made during recent years | 38 Nos. since 1982, out of which 21 Nos. are airlayers and 17 Nos. are grafts |
| 5. Total number of germplasm collections | 114 Nos. since 1982 |

During May 1992, an extensive survey was undertaken in Kolar district and the desirable types identified are furnished in Table-4.

Table-4. Germplasm collections made during 1992 (Chintamani)

Source	No. of accessions collected	Description of the material collected
1. State Horticulture Farm, Chikkadasarahally, Sidlaghatta taluk	1	Large fruit (100g) and bold nut (9.0g) type.
2. Private farm, Hogalegere village, Srinivasapura Tq.	2	High yielding type with an yield of about 50 kg per tree/year
3. Private Farm, Hebbari village, Srinivasapura Taluk	1	Bold nut type (10g/nut) with a cluster bearing habit
4. Private farm, Dinnur village, Mulabaghal Taluk	1	Bold nut type weighing 10.0 g/nut
5. Private Farm, Gollahally village, Mulabaghal taluk	1	Semi dwarf plant
	<u>6</u>	

Out of 114 germoplasm collections available for evaluation, 72 accessions are being evaluated for yield and yield parameters.

The results of 1991-92 revealed that seven accessions viz., ME 4/4 (15.45 kg/tree), 4/61 Alangudi (13.19 kg/tree), 3/108 Gubbi (12.75 kg/tree), 1/61 Alangudi (12.35 kg/tree), 5/23 Coondapur (10.30 kg/tree), 8/46 Taliparamba (10.30 kg/tree) and 1/64 Madhuranthakam (6.30 kg/tree) are high yielders (Table-5). The highest nut weight of 6.8g was recorded in ME 4/4 followed by 6.5g in 8/46 Taliparamba.

Higher shelling percentage of 32.5 was recorded in 1/64 Madhuranthakam followed by 32.3 in 5/23 Coondapur, 31.6 in ME 4/4 and 31.4 in 8/46 Taliparamba. However the least shelling percentage of 23.4 was in 1/61 Alangudi. 5/23 Coondapur had a compact canopy while all other six accessions displayed medium canopy.

1/64 Madhuranthakam and 3/108 Gubbi were early in flowering while the remaining five accessions were of mid season flowering habit.

The cumulative yield of these seven accessions for the last eight years ranged from 40.9 kg/tree in 5/23 Coondapur to 52.75 kg/tree in 3/108 Gubbi.

JHARGRAM

Like previous years, the survey was conducted for identification of elite plants. Eight elite plants were selected during 1992 from Midnapore district and the grafts of the same were planted at Regional Research Station, Jhargram. The details of the collections are given in Table-6.

Table-5. Yield performance of promising germplasm accessions (Chintamani)

Accession No.	Source of collection	Yr. of planting	Cumulative yield for 8 yrs (kg)	Cumulative yield range	Yield of reporting yr. (1991-92) (kg)	Mean nut wt. (g)	Shelling %	Flo- wering habit	Average wt (g)	Type of canopy
8/46 Taliparamba	Ullal	1982	50.80	36.5-58.0	10.30	6.5	31.4	Mid	23.0	Medium
1/64 Medhuranthakam	Ullal	1982	47.70	34.3-51.5	6.30	4.5	32.5	Early	16.2	Medium
3/108 Gubbi	Ullal	1982	52.75	34.1-59.8	12.75	4.3	27.8	"	20.1	"
4/61 Alangudi	Ullal	1982	50.19	40.5-48.9	13.19	4.4	27.5	Mid	16.5	"
1/61 Alangudi	Ullal	1982	48.05	34.6-50.3	12.35	4.1	23.4	Mid	15.2	"
5/23 Coondepur	Ullal	1982	40.90	28.6-43.1	10.30	4.0	32.2	Mid	26.5	Compact
ME 4/4	Ullal	1983	45.35	36.5-50.5	15.45	6.8	31.6	Mid	28.0	Medium

Table-6. Description of germplasm collected during 1992 survey (Jhargram)

Sl. No.	Source of collection	No. of accessions collected	Description of types collected
1.	Cashew Plantation, Dept. of Forest, Govt. of West Bengal Vil. Pukhuria PO Jambani Dist. Midnapore	4	(i) Plant is 18-20 years old, cluster bearing, 8-10 nuts/panicle, nut weight 6.0g, shelling percentage 34.2, average yield 25-30 kg. (ii) Age of plant is 20-22 years, cluster bearing, 10-15 nuts/panicle, nut weight 6.5g, shelling percentage 31.9, average yield 40-45kg (iii) 12-15 years old plant, cluster bearing, 7-11 nuts/panicle, nut weight 5.5g, shelling percentage 32.6, average yield 30-32 kg. (iv) Plant age is 15-20 years, cluster bearing, 10-15 nuts/panicle, nut weight 5.0g, shelling percentage 31.5, average yield 26-30kg <u>Note:</u> All the four accessions of Forest Dept. are growing without any management.
2.	Private orchard, Sri Mathur Mahato, Vil. Jangalkhas, PO Bikash Bherati, Midnapore Dist.	4	(i) Plant is 8-9 years old, nut size 6.0g, shelling percentage 31.8, average yield 8-10g. (ii) Age of plant is 9-10 years, nut size 6.0g shelling percentage 34.2, average yield 10-14kg (iii) 9-10 years old plant, cluster bearing, 12-25 nuts/panicle, nut size 3.5g, shelling percentage 30.6, average yield 20-25 kg. (iv) Plant age is 9-10 years, cluster bearing, 8-17 nuts/panicle, shelling percentage 34.8, average yield 18-22 kg.

Germplasm consisting of 111 accessions is maintained for evaluation. The accessions planted during 1983, 1984 and 1985 were evaluated and yield performance of 15 promising types are given in Table 7. Highest yield of 9.45 kg/tree was recorded in JGM. 66/7, followed by JGM. 80/2 (9.04 kg). The maximum mean nut weight of 7.5 g was observed in JGM. 34/3 while the same was 6.7 g, 5.6 g and 5.2 g in JGM. 16/6, JGM.68/9 and JGM. 71/5 respectively. Regarding shelling percentage the accession JGM. 79/5 ranked first (34.7%) followed by 33.8 per cent in JGM. 80/2, 32.1 per cent in JGM 68/9 and 31.5 per cent in JGM. 16/1.

MADAKKATHARA

A total of 115 accessions collected till 1992 were planted for evaluation in the clonal germplasm conservation block. Fifteen high yielding and tea mosquito tolerant accessions collected from Kannur, Palakkad districts and one released variety from Vengurla (V-6) were added to clonal germplasm conservation block during the year under report. The details of germplasm accessions are given below:

<u>Source of collection</u>	<u>No.of accessions collected</u>
Republic of Panama	14
Cashew Farm, Kottarakkara	11
Cashew Research Station, Madakkathara	26
CRS, Anakayam	24
NRC-Cashew, Puttur	8
Bapatla	8
Vengurla	6
Jhargram	1
Vittal	2
Farmers' fields in Kannur & Palghat	
Districts of Kerala	15
	<hr/>
	Total:115
	<hr/>

Table-7. Yield performance of promising germplasm accessions (Jhargram)

Sl. No.	Accession No.	Yr. of planting	Source of collection	Cumulative yield for last 5 years (kg)	Range	Yield of porting (1992) kg/plant	Mean nut wt. (g)	Shelling %
1.	JGM. 66/7	1983	CRS, Bhubaneswar	22.96	0.18-9.45	9.45	3.6	30.7
2.	JGM. 71/5	"	CRS, Madakkathara	20.29	1.28-7.52	7.52	5.2	29.7
3.	JGM. 10/2	"	CRS, Bhubaneswar	14.19	0.38-6.80	6.80	3.4	30.6
4.	JGM. 73/9	"	CRS, Madakkathara	8.47	0.21-3.51	3.51	4.7	25.4
5.	JGM. 10/3	"	CRS, Bhubaneswar	15.47	0.68-5.55	5.55	3.7	28.0
6.	JGM. 65/9	"	-do-	15.54	1.66-4.95	4.95	3.6	30.7
7.	JGM. 16/1	"	CRS, Madakkathara	17.41	2.21-4.86	4.86	4.1	31.5
8.	JGM. 20/6	"	CRS, Bhubaneswar	20.78	2.27-7.72	4.75	4.7	30.2
9.	JGM. 68/9	"	CRS, Bhubaneswar	11.37	0.09-4.59	4.59	5.6	32.1
10.	JGM. 16/6	"	CRS, Madakkathara	9.92	0.14-4.28	4.28	6.7	29.8
11.	JGM. 42/1	"	CRS, Vengurla	11.66	0.73-5.17	5.17	3.5	30.2
12.	JGM. 80/2	1984	Depal, Midnapore, WB.	17.63*	0.91-9.04	9.04	3.4	33.8
13.	JGM. 79/5	"	-do-	11.56*	0.65-6.04	6.04	3.6	34.7
14.	JGM. 34/3	"	CRS, Bapatla	8.96*	0.11-5.44	5.44	7.5	27.5
15.	JGM. 56/4	1985	CRS, Vridhachalam	8.36**	1.37-5.67	5.67	4.0	29.1

* Cumulative yield for last 4 years

** Cumulative yield for last 3 years

The accessions planted during 1988 have come to bearing and the biometric and yield characters were recorded. The accessions planted during 1990 had flowered, but the panicles were nipped off. The 16 accessions planted during 1992 have established well. The observations on the growth and flowering characters of the promising accessions planted during 1988 are given in Table-8. In general yield was poor in the entire germplasm conservation block due to the severe attack of tea mosquito especially on late flowering types.

VRIDHACHALAM

One hundred and fifty nine types representing the following sources multiplied by softwood grafting and planted in the field in September 1989 are being maintained, out of which 112 types are in different stages of flowering and fruit development during this season.

<u>Source of collection</u>	<u>No. of types</u>
Original seedling collection of germplasm	81
Narumanam Forest	28
Andimadam Forest	10
Pudukkottai Forest	12
Released varieties from RFRS Vengurla	6
Released varieties from CRS, Bapatla	6
Released varieties from CRS, Ullal	2
Introduction from NRCC, Puttur	6
Private holdings	8
Total:	159

Table-8. Biometric and flowering characters of promising accessions in clonal germplasm conservation block (Madakkathara)

Accession No.	Type/Variety	Source of collection	Plant height(m)	Plant habit	Girth(50 cm & above ground level)(cm)	Date of first flowering	Length of panicle (cm)	Breadth of panicle (cm)	No. of nuts/panicle
26	Brazil	Anakkayam	2.90	Semierect	38	01-11-92	18.11	19.55	11.2
27	"	BCA-39-4	2.75	Erect	35.33	05-11-92	15.33	17.00	11.7
28	"	K-22-1	3.03	Semierect	29.66	25-10-92	19.66	24.55	7.8
30		H-3-13	2.80	-do-	30	20-11-92	19.75	21.55	6.5
31		H-3-17	3.17	Spreading	33.75	01-11-92	21.88	30.11	7.5
32		H-680	3.12	-do-	38.75	01-11-92	14.55	23.22	8.9
44		H-1600	2.78	Bushy	32.25	28-10-92	20.44	26.77	11.5
46		H-1608	3.03	Semierect	37.75	30-10-92	17.55	20.22	8.2
49		A-26-2	2.75	Bushy	38.25	25-10-92	17.66	19.55	10.9

The type M 26/1 recorded the highest yield of 22.50 kg of raw nut per tree during 1992 season with a cumulative yield of 282.27 kg of raw nuts over a period of 22 years (upto 1992) (Table 9 and 10). This is followed by the type M 15/4 which has been already included under MLT, registered an yield of 10.72 kg of raw nuts with a cumulative yield of 272.12 kg. This type along with VRI-2 has been multiplied clonally and the grafts supplied to all the Coordinating centres for evaluation. A total number of 12 types have been isolated based on apple weight (80 g) and nut weight (8g) from among the germplasm during this season (Table-11). The type A 25/2 recorded the highest mean apple weight and kernel weight (125g and 2.26g) respectively and this is 213.3 and 6.6 per cent higher over the variety VRI-3. The ratio of nut to kernel is 3.5 which is almost equal to the variety VRI-3. In addition, a new type PU-6 introduced from NRCC, Puttur and planted in December 1988 came to harvest for the first time during February-March 1992. This type was found to be a shy bearer producing nuts and kernels weighing 11.2 g and 2.5 g respectively and this was the highest recorded so far among the germplasms. This type has been included as one of the parents in hybridization for improving the variety VRI-2.

Observations on flowering, apple and nut characters are being recorded. Besides a total number of 112 types of old germplasm of original seedling collection have been multiplied clonally and the same will be planted in the main field during the current planting season of July 1993 as the land was made available after clearing of old cashew trees only

Table-9. Yield performance of promising germplasm accessions (Vridhachalam)

Accession No.	Yield		Accession No.	Yield	
	No.	Weight		No.	Weight
M 7/2	217	1.030	M 7/3	50	0.250
M 10/4	293	1.530	M 15/4	1633	10.720
M 49/3	-	-	M 44/3	3170	22.010
M 45/1	643	2.965	M 55/1	40	0.200
M 55/4	5779	22.430	M 59/1	1650	8.630
M 61/2	1110	7.690	M 76/1	3240	7.030
M 79/4	2402	12.110	M 90/3	1406	7.390
M 110/2	1211	9.525	ME 4/4	3205	11.780
ME 5/2	1872	9.030	ME 15/2	1550	7.290
MA 3/4	3801	12.400	A 3/4	2370	10.100
A 6/1	3238	17.370	A 7/4	2273	11.410
E 3/1	1818	8.470			

Table-10. Yield characters of promising germplasm types

Acc. No.	Yr. of planting	Cumulative yield upto 1992	Range	Yield of reporting year	Mean nut wt.	Shell-ing %
M 3/2	1964	173.20	0.46-18.55	14.19	3.4	29.5
M 15/4	1964	272.12	7.73-30.20	10.72	6.9	28.5
M 26/1	1964	282.27	0.55-23.55	22.50	4.0	29.5
M 26/2	1964	225.84	2.17-22.58	10.25	6.8	30.5
M 44/3	1972	94.57	5.40-22.01	22.01	6.3	28.0
M 55/4	1964	190.27	3.85-22.43	22.43	4.7	30.0
M 59/2	1964	122.78	0- 14.40	12.60	4.6	20.5
M 110/2	1983	18.77	0- 9.53	9.53	6.9	27.5
ME 4/4	1964	128.04	0.10-24.30	11.78	4.4	26.5
MA 3/4	1964	66.40	0- 14.95	12.40	4.2	22.5
A 3/4	1964	66.38	0- 15.05	10.10	4.0	20.5
A 6/1	1964	89.72	0.08-17.37	17.37	5.5	29.5
A 7/2	1964	197.32	0- 27.70	11.41	5.9	28.3

Table-11. Apple and nut characters of promising types (Vridhachalam)

Acc. No.	Apple weight (g)	Nut weight (g)	Kernel weight (g)	Ratio of apple to nut	Ratio of nut to kernel
M 1/4	84.7	7.5	2.12	11.3	3.5
M 48/1	86.8	5.5	1.52	15.8	3.6
M 49/4	98.6	8.1	2.18	12.2	3.7
M 59/3	93.0	7.4	2.08	12.6	3.6
M 61/2	89.6	6.0	1.93	14.9	3.1
M 63/2	85.9	6.7	1.59	12.8	4.2
M 64/2	84.0	7.3	1.95	11.5	3.7
M 100/3	88.6	6.2	1.87	14.3	3.3
M 110/2	99.4	9.1	2.15	10.9	4.2
ME 16/3	98.9	5.7	1.38	17.4	4.1
A 25/2	125.0	7.9	2.26	15.8	3.5
V-3	91.7	8.1	1.75	11.7	4.6
VRI-1	62.4	5.7	1.52	10.9	3.8
VRI-2	50.9	5.9	1.74	8.6	3.4
VRI-3	58.6	7.5	2.12	7.8	3.5
M 15/4	65.9	7.2	1.94	9.1	3.7

during February 1993. The other Coordinating centres have been addressed for the supply of released and promising types and the list of varieties and types received from other Centres are furnished below:

<u>Varieties/Types</u>	<u>Source</u>
V-1 to V-6	
Kankadi	
Vetore-56	Regional Fruit Research Station, Vengurla, Maharashtra
Tulas	
Saha	
Bold nut types (5)	
Hy. 68, 255, 303, 320 and 367	
PU. 1, 2, 4, 6, 7 and 8 (6 types)	National Research Centre for Cashew, Puttur (Karnataka)
VTH 107/3	
VTH 40/1	
VTH 711/4	

Madakkathara-1
 Madakkathara-2
 K-22-1
 Anakkayam-1

Cashew Research Station,
 Madakkathara (Kerala)

Ullal-1
 Ullal-2

Agricultural Research Sta-
 tion (UAS), Ullal (Karnataka)

BPP-1 to 6
 30/1, 3/33, 10/9 &
 3/20 Rajahmundry

Cashew Research Station,
 Bapatla (Andhra Pradesh)

Bhubaneswar-1

Cashew Research Station (OUAT)
 Bhubaneswar, Orissa

Jhargram-1

Regional Research Station
 (BCKV), Jhargram (West Bengal)

VENGURLA

At present there are a total of 161 accessions in gene bank. Out of these, 80 types already have been evaluated and planted in conservation block at closer spacing (4 x 4m) and the remaining 81 types are being evaluated. The information on some of the promising selections has been given in Table-12.

In addition to above, 72 bold types have been procured from 1988 to 1992 and planted in the field. During the year under report the accessions have put forth flowering and fruiting. This year three promising bold^{nut} types have been identified as parents and included in the breeding programme. The brief information on three bold^{nut} types is given in Table 13. During the year under report two bold nut types were procured and grafts prepared for planting.

Table 13 Bold types identified for breeding programme in 1993 season (Vengurla)

Acc. No.	Nut wt. (g)	Shell-ing %	Av.wt.of kernels (g)	Yield (nut kg/tree)	Av. wt. of apple (g)	Tree canopy
1	12.0	25.0	3.4	5.47	80	Medium
22	12.0	24.0	3.2	5.98	86	Medium
65	12.0	28.0	2.8	3.65	82	Medium

Table -12. Promising germplasm accessions at Vengurla

Accn. No.	Source of collection	Year of planting	Cumulative yield for 6 yrs	Range	Yield of reporting yr.92 (kg nut/tree)	Mean nut wt(g)	Shelling %
80/2/4	M-6-1	1977	39.16	3.97-8.25	6.16	5.17	27.15
83/5/3	T.No.1 (Bapatla)	1977	47.39	6.69-10.07	5.04	6.08	27.65
87/9/2	H-3-17 (Anakkeyam)	1977	34.62	3.39-8.32	4.80	5.25	24.85
89/12/3	BLA-256 (Anakkeyam)	1977	38.37	3.39-13.16	5.22	5.30	30.72
94/17/5	Murude (ST 94)	1977	50.79	6.07-14.38	8.26	7.1C	23.0C
95/11/3	Seed Farm Collection No.1	1977	36.71	2.23-10.13	5.35	6.70	23.00
96/11/5	No.2	1977	37.06	3.87-9.13	5.22	5.44	22.00
92/12/15	No.4	1977	65.57	3.87-14.68	4.44	6.30	21.40
109/22/2	Poendi No.2	1979	35.34	2.10-8.99	6.66	5.00	25.00
124/15/3	Seed Farm Collection No.21	1979	32.57	1.30-9.14	5.25	6.80	29.55
126/17/2	No.23	1980	39.59	2.13-7.19	6.64	6.00	28.49

Gen.3: Expt.1: Varietal Evaluation Comparative yield trial
(Bapatla, Chintamani)

BAPATLA

The secondary selection from the seedling population of T.No.39, T.No.56 (BPP-6) and T.No.1 (BPP-5) were evaluated and the yield characteristics of promising types are presented in Table-14. . The types 30/1 (T.No.39), 3/33 (T.No.56) and 10/19 (T.No.1) gave cumulative yield of 316.7 kg, 242.2 kg and 248.5 kg respectively for the last 10 years. All the 24 types listed in Table showed nut weight above 5 g.

CHINTAMANI

The trial was planted during December 1986 with ten varieties of Bapatla and Vengurla in a RBD with three replications. The growth parameters, viz., plant height, stem girth, canopy shape, flowering period, number of panicles per m² and nut yield have been furnished in Table 15. The varieties did not significantly differed in plant height. The varieties were at par in the stem girth. The highest stem girth (17.79 cm) was in Vengurla-3 followed by Bapatla-3 and Vengurla-5 (17.53 and 17.23 cm respectively).

However, significant differences were observed amongst the varieties in nut yield. The highest nut (6.83 kg/tree) was recorded in the variety Vengurla-5 which was significantly superior to others. In the previous years also this variety recorded the highest yield.

Table 14: Performance of seedling population of secondary selections (Bapatla)

S.No.	Accession No.	Source of collection	Cumulative yield (1983-92) (kg)	Yield of 1992 (kg)	Mean nut wt. (g)	Shelling percentage
<u>T.No.39</u>						
1.	1/11	Bapatla	220.6	24.0	5.8	28.0
2.	2/1		147.3	6.5	5.4	28.0
3.	18/1		127.3	6.2	5.4	28.5
4.	30/1		316.7	30.0	6.8	28.0
5.	32/10		174.1	16.7	5.3	26.5
6.	28/20		170.4	15.5	7.4	27.0
<u>T.No.56</u>						
7.	3/33	Local	242.2	42.2	6.7	25.5
8.	12/17		162.5	14.4	5.7	26.0
9.	14/17		199.6	10.6	5.6	26.0
10.	19/9		161.5	5.0	5.4	28.0
11.	9/1		149.9	20.5	5.1	28.0
12.	9/11		241.2	32.2	5.7	28.0
13.	9/15		145.6	15.2	6.0	27.0
14.	17/10		145.3	6.2	5.4	29.0
15.	17/32		164.5	2.5	5.9	25.0
16.	21/23		143.6	4.7	5.8	26.0
<u>T.No.1</u>						
		Local				
17.	7/11		149.5	17.5	5.2	28.0
18.	10/19		248.5	22.5	5.0	28.0
19.	11/30		209.7	19.0	5.1	25.0
20.	15/32		142.3	12.2	5.0	25.0
21.	16/4		191.6	6.7	5.5	26.0
22.	16/24		198.5	10.5	5.0	28.0
23.	20/11		138.2	7.2	5.0	25.0
24.	20/12		171.7	14.7	5.6	27.0
			SEM	1.96		
			CD	5.75		

Table 15 . Growth and yield parameters of varietal evaluation trial in Cashew
(Chintamani)

Sl. No.	Variety	Height (m)	Girth (cm)	Canopy shape	Yield (%)	Flowering period	No. of panicles per m ² *
1.	Vengurla-1	4.23	16.4	Compact	2.50	Medium	20.23
2.	Vengurla-2	4.40	16.77	Medium	4.53	Long	12.70
3.	Vengurla-3	4.20	17.79	Sparse	2.37	Medium	9.65
4.	Vengurla-4	4.54	15.73	Sparse	3.17	Medium	6.84
5.	Vengurla-5	3.74	17.23	Compact	6.83	Medium	22.35
6.	Bapatla-1	4.23	16.03	Compact	2.50	Medium	24.96
7.	Bapatla-6	4.18	16.55	Compact	4.00	Medium	14.77
8.	Bapatla-3	3.73	17.53	Medium	4.83	Medium	17.76
9.	Bapatla-4	3.94	15.70	Medium	2.83	Long	14.62
10.	Bapatla-5	3.47	15.73	Compact	3.53	Medium	17.69
	CD at 5%	NS	NS		1.83		7.07

NS = Non significant

* Mean of four directions

It can be seen from Table 16 that the variety VTH-59/2 has recorded maximum height (5.03 m) amongst all the varieties while the variety Tree No.40 has recorded maximum tree volume (97.10 cub.m)/tree. As regards the girth, Hy.1610 (Madakkathara) has produced maximum stem girth (56.75 cm) at graft joint. Variety M 44/3 (Vridhachalam) has recorded lowest height, girth and volume followed by Hy. 2/15 and Hy.2/16.

Table 16. Multilocational trial in cashew-Growth and yield data 1993 (Vengurla)

Varieties	Av.hei- ght/pl- ant(m)	Av.girth per pla- nt (cm)	Volume/ plant (cub.m)	Average yie- ld/tree (kg/nut)
V-2	3.86	43.90	60.34	2.658
V-3	4.02	56.25	94.57	1.936
V-4	3.36	45.16	54.55	2.257
V-5	3.31	45.50	39.32	3.479
VTH 59/2	5.03	47.00	77.72	1.687
VTH 30/2	3.58	47.93	61.14	2.110
M 44/3	2.65	38.83	31.07	0.710
H 2/15	2.66	39.66	36.02	1.947
H 2/16	2.83	39.91	42.26	2.228
T. 40	3.48	51.16	97.01	1.053
T 129	3.50	35.60	42.16	2.378
H-1598	3.70	48.50	53.14	2.154
H-1600	2.96	49.25	47.77	3.540
H-1608	3.40	50.93	64.89	2.324
H-1610	3.71	56.75	69.03	2.544
SE±	0.392	2.24	10.01	0.358
CD at 5%	1.08	6.720	27.75	0.992

As regards the yield of nuts, Hy. 1600 (Madakkathara) has produced the maximum yield (3.540 kg) followed by Vengurla-5 (3.479 kg) and Vengurla-2 (2.658 kg).

Gen. 3: Expt. 2: Varietal evaluation-Multilocation trial with varieties from Vittal, Vridhachalam, Vengurla and Bapatla

(Bapatla, Bhubaneswar, Chintamani, Jhargram, Madakkathara, Vridhachalam and Vengurla)

The trial was laid out with clonal progenies. The following varieties are under evaluation in different centres:

Madakkathara	--	H 1598, H 1600, H 1608, H 1610
Bapatla	--	T 129, T 40, H 2/15, H 2/16
Vengurla	--	V-2, V-3, V-4, V-5, M 44/3
Vridhachalam	--	M 33/3, M 44/3, M 26/2
Vittal	--	30/4, 59/2, 44/3
Design: RBD		Replications: 3

BAPATLA

The trial was laid out with clonal progenies obtained from different centres with a view to study the comparative performance of pre-released varieties. The trial was started during the year 1988 and the observations and growth measurements in first Multilocation trial were recorded and are presented in Table 17. There was no significant difference between treatments with regard to height and girth of plants. However, H 2/15 recorded maximum mean height of 2.30 m followed by VTH 59/2 with 2.10 m. The entry H 2/16 has recorded maximum mean girth of 31.0 cm followed by VTH 59/2 with 30.0 cm. The tree No.129 of Bapatla entry recorded 1.25 kg yield.

Table 17. Growth and yield performance of cashew varieties in Multilocation trial (Bapatla)

Sl. No.	Variety	Height (cm)	Girth (cm)	Canopy shape	Yield (kg)
<u>Madakkathara</u>					
1.	H-1598	1.75	26.0	Medium	0.75
2.	H-1600	1.20	24.5	Sparse	--
3.	H-1508	1.30	22.5	Compact	--
4.	H-1610	1.50	27.0	Compact	0.50
<u>Vencurla</u>					
5.	V-2	1.60	22.5	Compact	--
6.	V-3	1.2	22.0	Compact	--
7.	V-4	1.5	18.5	Compact	0.50
8.	V-5	1.75	20.0	Compact	0.40
<u>Vittal</u>					
9.	VTH 30/4	1.50	25.0	Sparse	--
10.	M 44/3	1.30	23.5	Medium	--
11.	VTH 59/2	2.10	30.0	Sparse	0.40
<u>Bapatla</u>					
12.	T.40	1.56	25.0	Compact	0.60
13.	T.120	1.75	26.0	Sparse	1.25
14.	H 2/15	2.30	24.5	Sparse	0.75
15.	H 2/16	2.00	31.0	Sparse	--
<u>Vridhachalam</u>					
16.	M 26/2	1.85	26.5	Sparse	--
17.	M 33/3	1.25	20.0	Sparse	0.75
18.	M 44/3	1.40	24.5	Compact	--
	SEM \pm	0.07	0.75		
	CD at 5%	0.20	2.24		

BHUBANESWAR

The trial was laid out during 1989-90 with two replications in randomised block design.

Maximum plant height was recorded in V-2 (3.06) followed by VTH 30/4 (2.85), H1610 and 2/16 (2.77). The plant height varied from 1.5m to 3.06m.. The maximum yield was recorded in V-4, (2.40 kg/plant) followed by H-1608 (1.592) and 2/16 (1.335 kg/plant). The nut weight varied from 0.395 kg to 2.4 kg/plant (Table 18).

Table 18, Growth and yield performance (Bhubaneswar)

Variety	Height (cm)	Canopy shape	Yield/plant	Flowering period
H 1598	2.18	Compact	0.640	Early
H 1600	1.87	Compact	0.375	Late
H 1608	2.57	Compact	1.592	Mid-season
H 1610	2.77	Medium	0.880	Late
T.No.129	2.28	Sparse	0.775	Mid-season
T.No.40	2.35	Compact	0.805	Early
H 2/15	2.07	Compact	0.890	Early
H 2/16	2.77	Sparse	1.335	Early
M 44/3	1.87	Compact	0.450	Early
M 26/2	1.93	Compact	0.597	Mid-season
VTH 44/3	1.77	Compact	0.665	Early
VTH 30/4	2.85	Sparse	1.120	Late
VTH 50/2	1.5	Medium	0.325	Mid-season
V-2	3.06	Compact	1.344	Early
V-3	2.30	Sparse	0.600	Late
V-4	2.70	Sparse	2.40	Mid-season

CHINPAMANI

was laid out

The trial with 17 entries distributed in RBD and replicated thrice. The varieties of Vridhachalam, viz. M 33/3 and M 26/2 could not establish. In place, the varieties Ullal-1 and Ullal-2 have been planted during the year under report.

The growth and yield parameters of varieties from Vittal, Vridhachalam, Vengurla and Bapatla are furnished in Table 19.

The varieties did not differ significantly for plant height. However, the maximum (4.03 m) was observed in H-1598 and the lowest (2.93 m) was in T-40. The varieties differed significantly in the stem girth. The varieties were at par in their nut yield (Table 19). However, highest nut yield per tree was recorded by H-1600 (3.73 kg) closely followed by M 44/3 (3.70 kg). Significant differences ^{for} the number of panicles per m² was observed _{amongst} the varieties (Table 19). The highest number of panicles per m² was recorded by H-1600.

JHARGRAM

The growth parameters and yield performance were recorded and furnished in Table 20. The significant variations were observed in respect of plant height, girth and yield among the varieties. Maximum plant height (4.29 m) and girth (50.24 cm) were recorded in H-1610. Highest yield was recorded in VTH 59/2 (4.24 kg), H-2/16 (3.49 kg), H-2/15 (3.37 kg) and H-1598 (3.32 kg) as compared to other varieties.

MADAKKATHARA

Observations on plant height, stem girth (0.5 m above ground), canopy spread, flowering period, panicle and nut characters, apple characters and nut yield were recorded. The mean data are given in Table 21.

Table 19. Growth and yield parameters of MLT with varieties from Vittal, Vridhachalam, Vengurla and Bapatla (Chintamani)

Sl. No.	Variety	Height (m)	Girth (cm)	Canopy shape	Yield (kg)	Flowering period	No. of panicles per m ² *
1.	H-1598	4.03	18.50	Medium	2.30	Long	16.75
2.	H-1600	3.62	18.39	Compact	3.73	Long	31.30
3.	H-1608	3.44	16.70	Medium	2.13	Medium	26.91
4.	H-1610	3.76	17.08	Medium	2.77	Medium	30.99
5.	T-129	3.48	15.09	Medium	1.63	Short	16.67
6.	T-40	2.93	16.33	Compact	2.27	Long	30.30
7.	2/15	3.35	14.87	Compact	2.70	Medium	23.45
8.	2/16	3.52	15.19	Sparse	4.10	Medium	15.20
9.	M 33/3	2.98	15.37	Medium	1.77	Long	20.18
10.	VTH 30/4	3.63	15.95	Medium	1.63	Long	8.35
11.	VTH 59/2	3.34	16.97	Sparse	1.87	Medium	12.04
12.	M 44/3	3.14	14.59	Medium	3.70	Short	15.41
13.	Vengurla-2	3.09	13.86	Medium	2.27	Long	20.17
14.	Vengurla-3	3.19	16.89	Sparse	2.17	Medium	19.85
15.	Vengurla-4	3.22	15.70	Sparse	3.00	Medium	20.56
16.	Vengurla-5	3.58	15.06	Compact	3.43	Medium	20.93
17.	M-44/3	3.55	16.78	Compact	2.40	Long	14.16
	CD at 5%	NS	2.24		NS		6.93

NS = Non-significant
* Mean of four directions

Table 20. Growth and yield performance of varieties in multilocation trial (Jhargram)

Sl. No.	Varieties	Height (m)	Girth (cm)	Canopy shape	Yield/plant (kg)
1.	H-1598	3.70	47.21	Medium	3.32
2.	H-1600	3.39	39.32	Medium	2.96
3.	H-1608	3.56	45.53	Medium	2.42
4.	H-1610	4.29	50.24	Medium	2.63
5.	T.No.129	4.06	46.16	Sparse	3.07
6.	T.No.40	3.28	43.72	Medium	2.84
7.	H-2/15	3.71	44.23	Medium	3.37
8.	H-2/16	3.76	44.76	Medium	3.49
9.	M 33/3	3.81	43.71	Medium	2.65
10.	M-26/2	3.06	34.22	Sparse	2.72
11.	M 44/3	2.68	28.93	Sparse	2.29
12.	VTH-30/4	4.26	42.57	Medium	2.36
13.	VTH 59/2	3.94	43.28	Medium	4.24
S.E.m(+)		0.43	2.98	-	0.29
CD at 5%		NS	8.72	-	0.87

Vegetative growth was maximum in the variety H-1610 which recorded a mean height of 6.21 m and girth of 75.08 cm and the lowest vegetative growth was noticed in the variety M 44/3 with a mean height of 4.68 m and girth 65.08 cm. The variety M 26/2 from Vridhachalam produced the longest panicles (mean 23.25 cm). The mean length of the panicle was more than 20 cm in all the above varieties. The breadth of the panicle was maximum in V-2 (25.47 cm). Nut weight was maximum in the variety H-1608 which recorded a mean nut weight of 8.9g followed by H-2/16 (8.5g), H-2/15 (8.2 g) and V-4 (8.07g). The varieties H-1598, H-1600, H-1610, M-33/3, V-3, VTH-59/2 also produced nuts weighing 7g and above.

Apple weight was maximum in T-40 (mean 108.3g) and minimum in V-5 (mean 34.3 g). The highest nut yield (12.87 kg/tree) was obtained from the variety M-26/2 followed by the hybrids from Madakkathara.

Table 21. Growth characters and yield of different cashew varieties (Madakkathara)

Sl. No.	Variety	Height (m)	Girth (cm)	Canopy shape	Yield (kg/tree)	Flowering period
1.	H-1598	5.32	65.58	Compact	10.32	Mid-season
2.	H-1600	5.08	72.08	Medium	10.29	Mid-season
3.	H-1608	5.03	66.25	Compact	10.45	Mid-season
4.	H-1610	6.20	75.08	Medium	10.04	Mid-season
5.	VTH-30/4	5.05	65.10	Compact	7.53	Early-season
6.	VTH-59/2	5.25	63.91	Medium	7.39	Mid-season
7.	T-129	5.11	68.58	Medium	4.66	Mid-season
8.	T-40	4.76	63.83	Compact	4.92	Mid-season
9.	H-2/15	4.76	67.26	Compact	5.66	Early-season
10.	H-2/16	5.19	63.91	Medium	7.38	Early-season
11.	V-2	5.87	60.88	Medium	6.12	Early-season
12.	V-3	5.95	68.50	Sparse	9.59	Mid-season
13.	V-4	5.76	66.00	Medium	8.53	Mid-season
14.	V-5	5.33	63.83	Compact	8.03	Early-season
15.	M-33/3	5.19	57.25	Medium	8.86	Mid-season
16.	M-44/3	4.63	55.50	Compact	9.04	Early-season
17.	M-26/2	4.97	65.08	Compact	12.87	Mid-season
18.	Anakkayam-1	5.18	60.50	Medium	9.46	Early-season

VRIDHACHALAM

The yield, apple and nut characters recorded during 1992 season is furnished in Table 22. It was observed that the entry V-5 of Vengurla source registered the highest mean yield of 6.99 kg of raw nut per tree followed by 4.97 kg by the entry 59/2 of NRCC, Puttur. The largest apple in terms of weight and nut weight was found with V-4 (Vengurla source). The entry V-4 also showed the highest kernel weight of 2.35 g.

Table 22. Yield and yield parameters of MLT entries (Vridhechalam)

Sl. no.	Accession No.	Source of collection	Mean yield in 92 (kg)	Mean apple wt. (g)	Mean nut wt. (g)	Mean kernel wt. (g)
1.	H-1598	Madakkathara	3.14	61.3	6.6	1.87
2.	H-1600		1.31	67.9	7.6	1.81
3.	H-1603		3.16	65.7	7.5	1.99
4.	H-1610		1.91	61.6	8.4	1.99
5.	T.129	Bapatla	0.93	54.7	6.2	1.61
6.	T 40		2.73	62.6	6.2	1.59
7.	H 2/15		2.30	60.2	9.5	2.19
8.	H 2/16		1.30	64.2	9.6	2.16
9.	M 33/3	Vridhachalam	3.58	63.1	7.9	2.10
10.	M 44/3		2.69	50.9	6.5	1.74
11.	M 26/2		4.04	58.6	6.8	2.12
12.	30/4, 1	Puttur	3.26	55.4	7.0	1.86
13.	VTH 59/2		4.97	69.4	6.6	1.56
14.	V-2	Vengurla	4.25	55.3	5.3	1.73
15.	V-3		0.87	69.0	7.4	1.74
16.	V-4		3.76	84.2	9.1	2.35
17.	V-5		6.99	42.9	5.2	1.38

Gen. 3. Expt. 3: New multilocation trial with varieties from Bapatla, Vengurla, Vridhachalam, and NRC-Cashew, Puttur

(Bapatla, Bhubaneswar, Chintamani, Jhargram, Madakkathara, Vridhachalam and Vengurla)

BHUBANESWAR

The new multilocal trial was laid out during 1992 with 13 varieties (2 from NRCC, 4 from Bapatla, 5 from Vengurla and 2 from Vridhachalam) and replicated thrice. The cashew collection from Vridhachalam showed 80 per cent mortality in the field which requires gap filling. The plant height of different cultivars are presented in Table 23.

Table 23. Height of plant (Bhubaneswar)

Name of cultivar	Plant height in cm			
	R ₁	R ₂	R ₃	Average
NRC Selection-1	22.67	21.00	20.00	21.22
Selection-2	15.75	18.00	15.00	16.25
BPP-3/33	51.25	22.67	65.00	46.31
BPP-3/28	40.50	40.00	27.25	35.92
BPP-10/19	37.50	56.35	65.25	53.03
BPP-30/1	40.75	33.25	32.75	35.58
Ven. 302	25.00	27.25	30.75	27.83
H-68	23.00	30.75	27.70	27.15
H-255	32.50	34.00	23.25	29.58
H-302	35.00	32.25	26.00	31.08
H-368	20.75	34.25	22.25	25.75
M 44/3	17.67	18.35	16.95	17.42
M 15/4	-	29.00	-	-

The cashew type BPP-10/19 recorded highest plant height 53.03 cm, followed by BPP-3/33 (46.31 cm) and minimum plant height was recorded in NRCS-2 (16.25 cm) and M 44/3 (17.42 cm). Gap filling of M 15/4 will be done.

JHARGRAM

The clonal materials of bold nut types Vetore-56 and Kankadi from Vengurla and VTH 711 (Brazilian type) from NRC-Cashew, Puttur were collected and planted during 1992 for hybridization programme.

Gen. 4: Hybridization and Selection

(Bapatla, Bhubaneswar, Jhargram, Madakkathara,
Vridhachalam and Vengurla)

Objective

The objective of this experiment is to utilize the best yielders selected from germplasm and cross them with parents having other desirable traits like bold nuts, cluster bearing habit and compact canopy. The F₁ progenies are to be closely planted in initial selection plot and selected hybrid plants to be clonally multiplied for yield evaluation in a multilocation trial in different centres.

BAPATLA

During the year hybridisation was done with the following cross combinations and presented in Table 24.

Table 24. Details of hybridization (Bapatla)

Cross combination	Total no. of cross- es made	No. of nuts obtained	Percen- tage success
BPP-5 x Hy.2/22	420	89	21.1
BPP-6 x Hy.2/22	420	82	19.5
Hy.2/22 x BPP-5	380	78	20.5
Hy.2/22 x BPP-6	380	86	22.6
BPP-1 x BPP-5	420	62	14.7
BPP-2 x BPP-5	420	84	20.6
BPP-1 x T.273	420	70	16.6
BPP-2 x T.273	420	82	19.5
Total:	3280	633	19.2

- (a) BPP-5 and BPP-6 are high yielders and released types with nut weight more than 5g
- (b) Hy.2/22 is a bold nut type with a nut weight of 7.5g
- (c) T.No.1 and T.273 are parents of BPP-1 & BPP-2

The hybrid seedlings obtained from hybridization programme with selected parents of different cross combinations were planted during the period under report in the main field for studying their performance. The existing hybrid seedlings were evaluated and the performance of promising types are presented in Table 25.

Maximum mean yield of 24.6 kg for the last 10 years was recorded in Hybrid 3/28 followed by Hy.2/16 which has recorded 21.5 kg and 3/39 with 17.8 kg. Highest nut weight of 8.5 g and apple weight of 70 g were recorded in Hy.2/22 and Hy.2/16 respectively.

MADAKKATHARA

Out of a total number of 141 progenies obtained as a result of the hybridization carried out at this Centre from 1973-1979, 14 hybrids were identified as promising.

Of the 14 hybrids, two hybrids H-1598 and H-1608 were recommended for release by the State Varietal Release Committee during January 1992. They were released under the names Kanaka (H-1598) and Dhana (H-1608). The characteristic features of the varieties are given in Annexure-I and II. Clonal progeny of the hybrids H-856, H-1591, H-1596, H-1597, H-1600, H-1602 and H-1610 are being evaluated in a comparative yield trial at Madakkathara planted during June 1988.

As per the recommendations of the National Group Discussion of Cashew Research Workers held at CPCRI, Kasaragod from 30th August to 1st September 1991, the following cross combinations were identified for further hybridization.

Table 25. Evaluation of F₁ hybrids (Bapatla)

Sl. No.	Hybrid No.	Cross combination	Mean yield for the last 10 yrs. (kg)	Highest yield & age (kg)	Yield of 92 (kg)	Apple wt. (g)	Nut wt. (g)	Shelling %
1	1/4	1x40	8.2	21.8 (10th yr)	12.5	45.0	7.9	28.0
2	1/7	1x40	8.0	16.8 "	15.0	60.5	6.2	32.0
3	2/3	39x129	12.7	23.8 "	14.0	50.0	6.0	30.0
4	2/15	1x40	10.6	12.3 "	8.7	60.0	5.5	30.0
5	2/16	1x40	21.5	27.5 "	13.0	70.0	6.5	30.0
6	2/22	40x1	7.0	15.4 "	7.04	50.5	8.5	28.0
7	3/10	56x40	9.0	14.2 "	8.7	30.0	7.0	27.0
8	3/13	56x40	12.7	26.5 "	8.5	25.0	5.0	30.0
9	3/25	56xM-10/4	9.9	20.5 "	12.0	45.0	5.5	33.0
10	3/28	56xM-10/4	24.6	37.3 "	19.7	42.0	6.7	28.0
11	3/39	1x100	17.8	26.6 "	15.2	40.0	4.5	26.0
12	2/5	39x129	8.5	16.1 (12th yr)	14.3	67.0	5.1	30.0
13	2/10	39x129	9.0	14.9 "	14.9	62.0	4.6	27.5
14	4/1	1x100	8.7	16.7 "	16.7	51.0	4.0	30.0
15	5/2	1xM-10/4	8.5	17.5 "	17.5	60.0	5.2	28.0

SEM 1.32
C_D 4.03

1. BLA 139-1 x Vetore-56
2. BLA 139-1 x VTH 711
3. BLA 139-1 x Kankadi type

The programme will be started after the establishment of male parents. However, hybridization was started during January, 1993 with available materials. The crosses selected are:

1. BLA-139-1 (early type) x P-3-2 (Panama, bold nuts, less vigorous type)
2. BLA-39-4 (Medium) x P-3-2 (Panama, bold nuts, less vigorous type)
3. V-5 (Vengurla, cluster bearing) x H-1591 (bold nut)

(ANNEXURE-III)

VRIDHACHALAM

The nine elite F_1 progenies identified already in this trial are observed for yield, apple weight, nut weight and shelling percentage during the year 1992 (20th year of orchard life). Data recorded for the same is presented in Table 26. Data for the above said characters are not analysed statistically since only one type is present in each cross.

The nine F_1 progenies of 1971 planting continued to show their superiority by recording a mean yield of more than 5.0 kg/tree. The hybrid 4 (M 10/4 x E 4/2-1) recorded the highest mean yield of 6.310 kg/tree over a period of 11 years. The same cross also registered the highest yield of 6.330 kg of nuts/tree during the reporting year followed by M 33/3 x M 10/4-1 with 5.480 kg/tree.

Table 26. Performance of F₁ hybrids at Vridhachalam

Sl. No.	Cross combination	Hybrid No.	Mean yield for last 11 yrs (upto 92) (kg)	Highest yield obtained (kg)	W. of orchard life	Yield of reporting yr (1992)	Apple wt. (g)	Nut wt. (g)	Shell %
1.	M 33/3 x M 10/4-1	H-1	5.505	5.935	11	5.480	50.5	5.7	26.1
2.	M 33/3 x M 10/4-6	H-2	5.010	7.600	18	5.005	47.3	5.2	27.1
3.	M 33/3 x M 10/4-10	H-3	5.325	10.300	19	5.320	49.1	6.9	28.2
4.	M 10/4 x E 4/2-1	H-4	6.310	12.480	19	6.330	47.3	6.2	28.3
5.	M 10/4 x M 3/3-1	H-5	5.285	10.400	18	5.280	28.2	5.4	27.4
6.	M 10/4 x M 3/3-16	H-6	5.115	8.480	19	5.105	31.8	6.8	26.9
7.	M 26/1 x M 3/3-2	H-7	5.285	9.450	16	5.275	20.5	5.6	25.3
8.	M 26/1 x M 3/3-17	H-8	5.145	9.680	19	5.135	26.2	5.1	25.0
9.	M 33/3 x Selfed-3	H-9	5.235	10.620	19	5.225	62.6	8.0	27.8

Apple weight was maximum in H-9 of M 33/3 self-ed-3 (62.6 g). The same progeny also recorded the maximum nut weight of 8.0 g.

145 F₁ trees of different cross combinations planted during 1987 were evaluated for yield and tea mosquito bug incidence. Among them the hybrid 13 (26/2 x M 26/1) recorded the highest mean yield of 3.89 kg of nuts per tree (Table 27) during this year besides showing the highest mean yield of 3.91 kg of nuts per tree over a period of three years. The highest apple weight of 77.8 g was recorded by the hybrid 16. The highest shelling of 30.9 per cent was recorded by both the hybrids H-13 and H-15 respectively. Tea mosquito bug damage was very less in Hybrid-11 (0.70) being the cross of M 10/4 x M 45/4, followed by H-14 (M 26/2 x M 45/4) recording a score of 0.83.

Improvement of VRI-2 nut size

During the year 1992, crossing work was taken up to improve the nut size of VRI-2 with bold nut types viz. 2/15, 2/16, ME 3/2, H-1608 and M 33/3. A total of 54 seeds were obtained ^{from} these crossings and these were sown in polybags and the seedlings are ready for planting during 1993 planting season.

Crossing work for improving VRI-2 nut size was continued during 1993. The details of the crosses are presented in Table 28.

Table 27. Evaluation of F₁ hybrids for yield and tea mosquito bug (Vridhachalam)

Sl. No.	Cross combinations	Hybrid No.	Mean yield for last 3 yrs.	Highest yield obtained(kg/tree)	Orchard life (years)	Mean yield of re-planting yr. (1992) (kg)	Apple wt. (g)	Nut wt. (g)	Shelling %	Mean score of TMB damage
1.	M 10/4 x M 26/1	H-10	2.92	3.44	5	3.28	68.2	5.3	30.1	3.90
2.	M 10/4 x M 45/4	H-11	2.01	2.36	5	2.31	58.6	6.1	28.7	0.70
3.	M 10/4 x M 75/3	H-12	2.00	2.12	5	2.00	66.0	5.4	26.7	1.40
4.	M 26/2 x M 26/1	H-13	2.86	3.91	5	3.89*	63.1	5.4	30.9	1.82
5.	M 26/2 x M 45/4	H-14	2.77	2.97	5	2.92	55.8	6.1	30.2	0.82
6.	M 26/2 x M 75/3	H-15	1.93	2.17	5	2.11	61.2	5.1	30.9	1.23
7.	M 44/3 x M 26/1	H-16	2.53	2.84	5	2.76	77.8	5.2	28.4	1.90
8.	M 44/3 x M 45/4	H-17	1.71	2.01	5	1.83	64.9	5.3	28.7	0.90
	SED	-	-	0.41	-	0.49	1.8	1.3	2.9	0.34
	CD (P=0.05)	-	-	1.03	-	1.24	3.46	2.16	5.83	0.64

Table 28. Details of cross combinations (Vridhachalam)

Cross combinations	No. of flowers crossed	No. of nuts obtained	Percentage fruit set
M 44/3 x 2/15	25	4	16.0
M 44/3 x 2/16	37	7	19.0
M 44/3 x ME 3/2	84	21	25.0
M 44/3 x H 1608	78	23	29.5
M 44/3 x M 33/3	102	31	30.0

The percentage of fruit set ranged from 16 to 30 per cent with the highest found with cross combination of M 44/3 x M 33/3. The nuts obtained from each cross will be raised in the polythene bags during June-July, 1993 for taking up planting during October-November, 1993.

VENGURLA

During the year 1992-93, the crossing work was undertaken with the following eight cross combinations. The seedlings of F-1 progenies will be raised soon and these seedlings will be planted in the field in June, 1994.

Cross combinations	No. of nuts collected
Vengurla-2 x Bold type No.1	36
Vengurla-2 x Bold type No.22	76
Vengurla-2 x Bold type No.65	81
Vengurla-5 x Bold type No.1	49
Vengurla-5 x Bold type No.22	49
Vengurla-5 x Bold type No.65	59
Vengurla-4 x T 2/16	36
T 2/16 x Vengurla-4	57
Total	443

A total of 1431 F-1 hybrids have been planted during the period 1983 to 1991 and are under evaluation. The yield performance of 18 promising hybrids which were planted during 1983 and 1984 is given in Table 29. The hybrid No.255 gave highest yield (15.25 kg) followed by Hybrid No.336 (12.50 kg). The cumulative yield of past seven years was found to be maximum in Hybrid No.360 (61.45 kg). The nut weight and shelling percentage in all the hybrids were above 6.0 g and 27.0 respectively. Hybrid No.255, 303, 320 and 367 have been included in New multilocation trial. The total of 195 F-1 seedlings obtained from six cross combinations will be planted in the field at 6 x 6m spacing in the month of July 1993.

Table 29. Yield performance of promising hybrids planted in 1983 and 84 (Vengur-1a)

Hybrid No.	Cross combinations	Cumulative yield of last 7 yrs. (kg)	Yield range	Yield of porting yr. 93 (kg)	Wt. of nut (g)	Shelling %
240	Vengurla-3 x M 44/3	52.33	2.90-11.11	10.54	8.00	27.50
248	V-3 x M 44/3	46.70	3.40-10.39	10.39	6.21	28.00
255	V-3 x M 10/4	44.29	2.54-15.25	15.25	8.00	30.50
289	V-3 x M 10/4	34.38	1.30-11.66	5.600	7.25	28.00
303	V-4 x M 10/4	34.50	2.37-7.27	7.270	8.92	27.00
320	M 44/3 x Vetore-56	41.42	3.05-14.79	7.270	7.45	31.60
336	M 10/4 x Vetore-56	51.81	3.66-12.50	12.50	7.09	28.00
337	M 10/4 x Vetore-56	57.24	2.95-11.55	10.00	6.72	30.00
339	M 10/4 x Vetore-56	42.13	3.87- 8.75	3.68	6.65	29.00
340	M 10/4 x Vetore-56	42.73	3.39-8.35	8.35	7.37	28.00
360	V-5 x Vetore-56	61.45	3.35-13.36	8.260	7.37	28.50
367	V-4 x M 10/4	44.32	1.70-10.58	10.58	8.31	28.00
444	M 10/4 x Vetore-56	37.17	1.46-9.27	9.270	7.50	28.50
445	do-	44.75	2.38-9.010	6.660	7.50	28.50
454	M 10/4 x Vetore-56	45.12	1.71-11.76	5.320	8.00	28.60
453	do-	27.42	1.50-7.65	3.730	8.20	28.00
509	Vengurla-4 x M 44/3	41.36	1.05-9.28	8.730	6.00	29.00
304	Vengurla-4 x M 10/4	49.74	2.55-8.27	7.270	6.75	29.00

DESCRIPTION OF HYBRID H-1598 (KANAKA)

1. Name of the Station	Cashew Research Station Madakkathara 680656, (KAU)
Type Number	H-1598
a) Plant height	7.3 m
b) Distinguishing morphological characters	
i) Canopy type	Medium
ii) Branching	Intensive
iii) Laterals in lm^2	42
iv) Flowering laterals	15
v) Average no. of panicles in lm^2	16
vi) Flowering season	November-January
vii) Flowering duration	61 days
viii) Sex ratio	26.25 : 73.75 (Bisexual flower : Male flower)
ix) Inflorescence shape	Pyramidal
x) Apple colour	Yellow
xi) Weight of apple	73 g
xii) Percentage of juice	64.1
xiii) Quality of juice	Slightly astringent
xiv) TSS	12.1
xv) Sugar content	12.81
c) Yield characters:	
i) Cumulative yield (for the last 10 years (1982-91))	178.88 kg
ii) Annual yield for last 4 years(kg)	1988 - 20.80 1989 - 24.50 1990 - 20.70 1991 - 20.40
iii) Nut weight	6.8g
iv) Nut length	3.0 cm
v) Nut breadth	2.44 cm
vi) Nut thickness	1.90 cm
vii) Shelling percentage	40.3
viii) Kernel weight	2.08

- | | |
|--|--------------------------------------|
| ix) Kernel count | 258/lb |
| x) Export grade | W 280 |
| xi) Maturity group
(early medium and late
wherever such classification exists) | Early |
| d) Reaction to major diseases under field and controlled conditions
(Reaction to physiological strains, races, bio-types to be indicated wherever possible) | On par with other released varieties |

DESCRIPTION OF HYBRID H-1608 (Dhana)

Name of the Station	Cashew Research Station, Madakkathara (KAU)			
Type number	H-1608			
a) Plant height	7.0 m			
b) Distinguishing morphological characters				
i) Canopy type	Medium			
ii) Branching	Intensive			
iii) Laterals in lm^2	42			
iv) Flowering laterals	22			
v) Average number of panicles in lm^2	22			
vi) Flowering season	December-January			
vii) Flowering duration	62 days			
viii) Sex-ratio	58:42 (Bisexual flowers: Male flowers)			
ix) Inflorescence shape	Conical			
x) Apple colour	Yellow			
xi) Weight of apple	74g			
xii) Percentage of juice	58.56			
xiii) Quality of juice	Highly astringent			
xiv) TSS	11.4			
xv) Sugar content	10.2			
c) Yield characters				
i) Cumulative yield (average for last 10 years 1982-91)	164.85 kg			
ii) Annual yield for last 4 years	1988	1989	1990	1991
	<u>14.40</u>	<u>14.80</u>	<u>19.40</u>	<u>11.30</u>
iii) Nut weight	9.6g			
iv) Nut length	3.35 cm			
v) Nut breadth	2.79 cm			
vi) Nut thickness	2.09 cm			
vii) Shelling percentage	27.08			
viii) Kernel weight	2.22 g			
ix) Kernel count	204/lb			
x) Export grade	W 210			
d) Maturity Group (early, medium and late wherever such classification exists)	Mid-season			

- e) Reaction to major disease under field and controlled conditions (Reaction to physiological strains, races bio-types to be indicated wherever possible) On par with other released varieties
- f) Reaction to major pests (under field and controlled conditions including store pests) On par with other released varieties

ANNEXURE-III

DESCRIPTION OF PARENTS

	Female		Male	
	BLA-139-1	BLA-39-4	P-3-2	H-1591
	V-5 (Vengurla)		(Panama)	
1. Maturity group	Early	Middle	Middle	Middle
2. Canopy type	Spreading	Erect	Bushy-less vigorous	Erect
3. Branching	Intensive	Intensive	Intensive	Intensive
4. Flowering season	Oct-Nov	Nov-Dec	Nov-Dec	Nov-Dec
5. Average yield	12 kg	13 kg	Not established	12.7
			yr. of planting)	
6. Nut weight	5.59g	6.2g	7g	10.9g
7. Kernel weight	1.85g	1.7g	-	2.58g
8. Shelling percentage	28.0	26.8	-	28.5
9. Kernel count	247	267	-	176

II. CROP MANAGEMENTA. AGRONOMY

Agr. 1: NPK fertilizer experiment

(Bapatla, Bhubaneswar, Chintamani, Jhargram,
Madakkathara, Vridhachalam and Vengurla)

Objectives

The main objective of this experiment is to study the NPK requirement for vegetatively propagated material of cashew

Treatments

N	:	0,	500,	1000	g/tree
P ₂ O ₅	:	0,	125,	250	g/tree
K ₂ O	:	0,	125,	250	g/tree

Design

3³ factorial confounded design with 27 treatments

Replications

Two

BAPATLA

The experiment was laid out during the month of December 1992. The plants are growing well. Watering is done regularly.

The soil is analysed for available N,P,K contents before laying out the experiment. The available N P K contents of soil are 68 kg N, 4 kg P₂O₅ and 7 kg K₂O/ha respectively.

BHUBANESWAR

The trial was laid out as per the treatments and design. Application of nitrogen significantly increased the yield over control and showed linear trend. So, also application of P_2O_5 and K_2O increased the yield significantly over control. Interaction of NP, N, K and PK showed significant variation in yield (Table 30).

Table 30. Effect of NPK on yield of nuts (kg/plant)
(Ehubeneswar)

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	1.921	1.950	2.048	1.973	1.840	1.962	2.118
N_1	2.743	2.920	3.117	2.927	2.567	3.012	3.202
N_2	3.460	3.617	4.072	3.716	3.342	3.810	3.997
Mean	2.708	2.829	3.079	-	2.583	2.927	3.100
K_0	2.583	2.712	2.830				
K_1	2.522	2.877	3.088				
K_2	2.643	3.195	3.398				

SE(m) \pm for N, P, K = 0.053

CD 5% for N, P, K = 0.109

SE(m) for NP, NK, PK = 0.075

CD 5% for NP, NK, PK = 0.155

CHUNTAANI

The trial was laid out during 1987 with 27 treatments in a 3^3 factorial confounded design with two replications. The grafts of the variety Ullal-1 were used in this trial and planted at a spacing of 7.5m x 7.5m.

During the year under report, the fertilizers were applied in two splits as per the treatment given

below. The first split dose was applied during August, 1992 and the second split dose during last week of September 1992. N was given in the form of Urea, P_2O_5 in the form of single super phosphate (like in previous years, Rock phosphate was not available as such P was given in the form of single Super phosphate), and K_2O in the form of Muriate of Potash.

N	:	0 (N_0), 500 (N_1), 1000 (N_2) g/plant/year
P_2O_5	:	0 (P_0), 125 (P_1), 250 (P_2) g/plant/year
K_2O	:	0 (K_0), 125 (K_1), 250 (K_2) g/plant/year

Each treatment consists of four plants.

The recommended package of practices were given for the crop. The data on nut yield per tree recorded during May 1992, plant height and stem girth are presented in Tables 31-33.

Table 31 Effect of different levels of NPK and their interaction on nut yield (kg/tree/year) (Chintamani)

	P_0	P_{125}	P_{250}	Mean	K_0	K_{125}	K_{250}	Mean
N_0	0.69	1.36	1.23	1.09	0.63	0.76	0.64	0.67
N_{500}	0.80	1.15	0.99	0.98	1.10	0.84	0.99	0.97
N_{1000}	0.71	0.67	0.86	0.74	0.65	0.67	0.93	0.75
Mean	0.73	1.06	1.02		0.79	0.75	0.85	
K_0	0.89	0.84	0.66	0.79				
K_{125}	0.48	0.82	0.97	0.75				
K_{250}	0.82	0.95	0.88	0.85				
Mean	0.73	0.83	0.83					

CD at 5%

N, P, I.	NS
NP, NK, PK	NS

NS = Non-significant

Plant height : Significant differences in plant height were observed to different levels of K_2O and interaction of P_2O_5 and K_2O levels. Application of 125g K_2O /plant per year recorded significantly higher plant height (3.94 m) than 250g K_2O /plant/year and without application of K_2O (3.27 and 3.48 m) and they were at par. Amongst different interactions plants differed in their plant height only to P_2O_5 and K_2O interactions, while other interactions were nonsignificant. All the combinations of different levels of P_2O_5 and K_2O were at par except the combination of 250g each of P_2O_5 and K_2O per plant per year. The maximum plant height (3.63 m) was recorded in the application of 125g per plant per year and without K_2O , closely followed by application of 250g per plant per year (Table 32).

Stem girth: Stem girth did not differ significantly to different levels of N, K_2O and the interaction of different levels of N, P_2O_5 and K_2O (Table 33). However, stem girth differed significantly to different levels of P. Application of 250g P_2O_5 per tree per year recorded significantly higher stem girth (17.53 cm) than other two levels of P_2O_5 which were at par.

Nut yield: Significant differences were not observed in nut yield to different levels of N, P and K and their interactions (Table 31). However the highest yield per tree per year (1.36 kg) was recorded in the without application of N plus with 125 g P_2O_5 . The lowest nut yield per plant per year (0.48 kg) was in the without application of P_2O_5 plus with 125 g K_2O .

Table 32. Effect of different levels of NPK and their interactions on plant height (m)

	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂
N ₀	3.42	3.39	3.76	3.52	3.51	3.75	3.31
N ₁	3.24	3.27	3.48	3.33	4.11	3.29	3.14
N ₂	3.50	3.63	3.65	3.59	4.22	3.71	3.38
Mean	3.38	3.43	3.63		3.48	3.94	3.27
K ₀	3.33	3.63	3.60				
K ₁	3.48	3.75	3.39				
K ₂	3.36	3.39	3.07				

	SEM ±	CD at 5%
K	0.08	0.24
PK	0.15	0.44
NK/NP	0.15	NS

Table 33. Effect of different levels of NPK and their interactions on stem girth (cm)

	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂
N ₀	15.22	16.21	17.68	16.37	16.08	16.91	16.12
N ₁	15.55	15.87	17.49	16.30	16.04	16.78	15.74
N ₂	16.18	16.21	17.42	16.60	16.96	17.14	15.70
Mean	15.65	16.09	17.53		16.48	16.94	15.85
K ₀	15.67	16.35	17.42				
K ₁	16.46	15.87	18.49				
K ₂	14.81	16.07	16.68				

	SEM ±	CD at 5%
N/K	0.35	NS
P	0.35	1.02
NP/NK/PK	0.60	NS

JHARGRAM

The experiment was laid out in 1981 with 3^3 factorial confounded design and two replications on Red hazari variety. The results of the experiment are given in Table 34 . The yield per plant was increased significantly with application of medium level of phosphorus (P_{205}). Maximum yield of 3.37 kg/plant was recorded in plants receiving 300g N, 200g P_{205} and 600g K_2O ($N_{300} \times P_{200} \times K_{600}$). However, the interactions of N x P and N x K also showed the significant difference in yield (Table 34).

New NPK trial with clonal progenies of Jhargram-1 (TN-16):Doses

N	0	500	1000 g/plant
P_{205}	0	125	250 g/plant
K_2O	0	125	250 g/plant

The planting of soft wood grafts of Cv. Jhargram-1 has been made for conducting new NPK fertilizer experiment.

Table 34 . Effect of different levels of NPK and their interactions on yield performance (kg/tree) of cashew (Jhargram)

	P_0	P_{200}	P_{400}	Mean	K_0	K_{300}	K_{600}
N_0	1.25	1.00	1.62	1.29	1.17	1.07	1.63
N_{300}	0.94	2.30	1.08	1.44	1.23	1.09	2.01
N_{600}	0.92	1.39	1.37	1.22	1.18	1.60	0.90
K_0	0.70	1.58	1.28				
K_{300}	1.29	1.27	1.19				
K_{600}	1.10	1.83	1.59				

S.Em (+) for N, P and K = 0.139
 CD for P at 5% level = 0.405

Ctd.....

S.Em (+) for NP, PK and NK	= 0.241
CD for NP and NK at 5% level	= 0.702
S.Em (+) for NPK	= 0.418
CD for NPK at 5% level	= NS

VRIDHACHALAM

This trial was relaid during the month of February 1993 with VRI 2 cashew by using 3^3 factorial confounded design having two replications. Each treatment consists of four trees. The treatments to be adopted are as follows:

N	0, 500	1000 g/tree
P ₂ O ₅	0, 125	250 g/tree
K ₂ O	0, 125	250 g/tree

After planting grafts were protected with plant guards. The stand of the graft is satisfactory and gap filling will be taken up during June 1993.

VENGURLA

This trial has been initiated in July 1990 and is at initial stage. The gaps observed have been filled and plants are growing satisfactorily. The growth parameters i.e., girth and height have been recorded.

Agr. 3: Foliar application of Urea along with insecticides

(Bapatla, Bhubaneswar, Jhargram, Madakkathara, Vridhachalam, Vengurla)

Objective

The objective is to study the efficacy of combined spray of urea and endosulfan on yield of cashew and control of pests.

Treatments

- T₁ - Soil application of 500, 250, 250g N, P₂O₅ and K₂O respectively per tree + endosulfan spray thrice
- T₂ - Soil application as above + 2% urea and endosulfan spray
- T₃ - Soil application as above + 3% urea and endosulfan
- T₄ - Soil application as above + 4% urea and endosulfan
- T₅ - Soil application of 250, 250g P₂O₅ and K₂O respectively + 2% urea and endosulfan spray

(Three sprays were given coinciding with flushing, flowering and fruiting stages)

Design

RED

Replications

Four

BAPATLA

The total dose of fertilizer was applied during the month of August. Three sprays with different concentrations of urea along with endosulfan were given coinciding with flushing, flowering and fruiting stages. The leaf samples were collected before and 48 hours after spraying for analysis of leaf nitrogen (Table 35)

Table 35 Effect of foliar application of urea along with endosulfan on yield and leaf nitrogen content. (Bapatla)

Treat- ment	No. of flower- ing pa- nicles/ sq.m.	No. of nuts/ plant	Yield (kg/ plant)	Shell- ing %	% leaf nitro- gen		% Tea mosqu- ito damage
					Before spray	After spray	
T-1	12.9	1578	8.1	26.5	1.80	1.76	Nil
T-2	15.3	2283	12.1	27.0	1.86	1.93	
T-3	12.9	1826	9.8	26.0	1.81	1.84	
T-4	12.8	1730	9.9	26.5	1.80	1.75	
T-5	10.4	1561	7.6	26.0	1.58	1.64	
SEM±	1.32	318.9	1.62	0.460	-	-	
CD at 5%	NS	NS	NS	NS	-	-	

The above data indicates that the treatments have no significant effect on any of the characters studied. However, T-2 has recorded the maximum number of panicles (15.3 per sq.m), no. of nuts and yield (2283 and 12.1 kg per tree) and shelling percentage (27.0) followed by T-4 (9.9 kg), T-3 (9.8 kg) and T-1 (8.1 kg). The lowest yield was recorded by T-5 (1561 nuts and 7.6 kg/tree), wherein nitrogen was applied only through foliar spray of 2% urea.

BHURANESWAR

The fertilizer was applied as a single dose during the month of July. Three sprays of different concentrations of urea along with endosulfan were given coinciding with flushing, flowering and fruiting stages. The leaf nitrogen was analysed before and after spray. The data presented in Table 36 indicates that there was significant differences in number of panicles/sq.m, number of

nuts and yield/plant. Maximum nut yield was recorded in T-3 (3.73 kg/plant) followed by T-2 (3.55 kg) and minimum in T-5 (1.8 kg).

Table 36. Effect of foliar application of urea and endosulfan on yield and leaf nitrogen content (Bhubaneswar)

Treatments	No. of flowering panicles/sq.m.	No. of nuts/plant	Yield/plant (kg)	Shell-ing %	% Leaf N	
					Before spray	After spray
T-1	18.80	556.00	2.67	30.2	2.16	1.68
T-2	20.67	726.75	3.55	30.4	2.16	1.85
T-3	19.70	777.50	3.73	30.6	2.20	1.68
T-4	18.16	673.50	3.18	30.6	2.10	1.68
T-5	17.22	396.00	1.81	30.3	1.85	1.35
SE (m) +	0.705	86.10	0.17			
CD 5%	1.536	87.70	0.37			

JHARGRAM

The fertilizer was applied as a single dose during the month of August. Three sprays of different concentrations of urea along with endosulfan were given coinciding with flushing, panicle emergence and fruit setting stages. The leaf samples were collected before spraying and 48 hours after each spray for estimation of leaf nitrogen content.

The yield, pest infestation and leaf nitrogen content of the treated plants are presented in Table 37. There is no significant difference in respect of number of flowering panicles per sq.m. and number of nuts/plant,

Table 37. Effect of foliar application of urea along with insecticides on yield, leaf nitrogen and tea mosquito incidence (Jhargram)

Treat- ment	N. of flower- ing pa- nicles/ sq.m.	No. of nuts/ plant	Yield/ plant (kg)	Shell- ing %	% Leaf nitrogen			% tea mosquito damage		
					Before spray	48 hrs after First spray	Second Third spray	Shoot	Inflore- sceñce	
T-1	23.8	751	2.494	31.26 (33.95)	1.67	1.87	1.91	1.78	2.00	2.50
T-2	31.2	1631	5.861	36.60 (37.21)	1.42	1.93	2.68	2.36	1.50	1.00
T-3	27.6	1133	4.284	36.81 (37.34)	1.74	2.24	2.37	1.83	1.75	1.50
T-4	24.3	814	2.852	32.16 (34.51)	1.56	1.89	2.46	2.35	2.00	1.25
T-5	21.7	692	2.684	29.05 (32.59)	1.98	2.04	2.21	2.06	2.25	2.00
S.E.m (+)				2.58	311.83	0.87	1.09			
CD at 5%				NS	NS	2.68	3.35			

Figures in parentheses represent angular transformed value

among the different treatments. However, the plants receiving T-2 treatment recorded maximum number of panicles/sq.m. (31.2) and nuts/plants (1631) whereas the same were minimum under T-5 treatment (21.7, 692). But significant variations in respect of both yield per plant and shelling percentage were observed among the different treatments. T-2 treatment recorded highest yield per plant (5.861 kg) followed by T-3 (4.284 kg) and minimum yield (2.494 kg) was observed in T-1 treatment. The shelling percentage varied from 32.59 to 37.34 per cent, it was maximum in T-3 treatment and minimum in T-5 treatment. Variations in leaf nitrogen content also observed. The tea mosquito damage did not show any great variation among the treatments. However, less incidence was noticed in plants under T-2 and T-3 treatments.

MADAKKATHARA

The trial was taken up during October 1989 as per the decisions of the IX Biennial Workshop of the Project held at Coimbatore during 1989.

The sprays were given thrice (during flushing, flowering and nut formation stages). Leaf samples were collected for analysis of N per cent before the first spray and after the third spray.

The mean number of nuts/tree was highest in T-3 (application of 3% urea with endosulfan) followed by T-4 (4% urea with endosulfan) and T-2 (2% urea with endosulfan). The above three treatments were significantly superior to T-1 (spraying endosulfan only) and T-5 (application of 2% urea + endosulfan without soil application of N). Foliar application of urea at different concentrations along with endosulfan did not have any effect on shelling percentage of nuts (Table 38).

Table 38. Effect of foliar application of urea along with insecticides on yield, leaf nitrogen and tea mosquito incidence (Madakkethara)

Treat- ment	No. of panic- les/m ²	No. of nuts/ plant	Yield (kg/tree)	Shell- ing %	Percentage of leaf nitrogen Before spray	After spray	Tea mosquito infesta- tion		Panicle	
							Shoots Perc- enta- ge	Mean sco- re	Mean Perc- enta- ge	Mean sco- re
T-1	28	717	3.940	29.20	1.295	1.456	12.00	0.20	58.25	0.69
T-2	26	1128	6.220	27.60	1.310	1.682	11.00	0.32	40.75	0.82
T-3	25	1524	8.360	28.70	1.305	1.748	10.23	0.13	41.33	0.49
T-4	25	1230	6.900	28.40	1.310	1.798	20.00	0.20	55.44	1.10
T-5	28	543	3.040	27.90	1.320	1.593	12.23	0.14	45.20	0.54

VRIDHACHALAM

Data recorded for mean number of flowering panicles/sq.m., number of nuts/tree, yield, shelling percentage, incidence of tea mosquito bug damage on panicle and shoot, besides analysis of leaf nitrogen pre- and post-spray were statistically analysed and presented in Table 39 . It could be seen that 4 per cent spray recorded the maximum number of flowering panicles (31.0) per sq.m., while the treatment-5 (zero 'N' as basal) had less number of flowering panicles/sq.m (21.3). The same T-4 treatment was found with the highest number of nuts/tree, highest yield and more shelling percentage of 1188, 5.940 kg and 28.7 per cent, respectively. This was closely followed by 3 per cent urea spray (T-3) for all the above characters. However, both the treatments were on par for all the above said characters (Table 39)

From the data it is clear that there is correlation between leaf nitrogen and the percent of tea mosquito damage. Though T-4 treatment recorded the highest yield, the TMB damage was severe recording 14.3 per cent in the panicle and 1.80 per cent in the shoot having a leaf N of 1.88 per cent whereas T-5 and T-1 recorded lesser incidence of TMB damage in both zero N basal as well as no foliar spray plots.

Table 39 Yield data on foliar application of urea along with insecticides (Vridhachalam)

Treat-ments	Mean no. of flowering panicles/sq.m.	No. of nuts/tree	Yield (kg)	Shell-ing %	Percentage of leaf nitrogen Before spray	After spray	Tea mosquito bug damage in Shoots (%)	Panicles (%)
T-1	24.7	515	2.755	27.9	1.736	1.801	1.17	9.7
T-2	24.9	993	4.569	27.8	1.736	1.825	1.52	13.0
T-3	30.1	1116	5.850*	28.2	1.736	1.859	2.12	16.7
T-4	31.0	1183	5.940*	28.7	1.736	1.883	1.80	14.3
T-5	21.3	497	2.458	27.3	1.238	1.254	1.17	12.2
SE (D)	2.3	88.6	0.95	0.92	0.73	6.251		
CD (P=0.05)	3.67	252.1	2.03	1.62	1.47	0.667		

It can be seen from the table 40 that the foliar application of urea @ 3 and 4 per cent has increased the yield to a greater extent along with a better control of tea mosquito. The leaf analysis for 'N' content is in progress.

Table 40 Foliar application of urea along with insecticides (1992-93) (Vengurla)

Treat- ment	No.of flower- ing panicles/ sq.m.	Yield (kg nut/tree)	No.of nuts/ tree	Shell- ing %	TMB in- cidence (% infes- tation in panicl- es)
T-1	35.50	7.150	1215	30.00	13.42
T-2	39.70	8.300	1410	30.70	14.50
T-3	40.60	11.200	1848	29.24	9.50
T-4	40.40	11.870	1958	30.50	8.62
T-5	36.30	6.940	1110	29.50	10.37
SE + CD at 5%		2.005 NS			

Agr. 4: Spacing trial
(Jhargram and Vengurla)

The objective of this experiment is to find out the optimum plant population per unit area for maximising the yield.

JHARGRAM

The trial was laid out in RBD with 12 treatments during the year 1982. The results (Table 41) indicated that significant variation exists in respect of number of nuts per plant, yield per plant and yield per block among the different treatments. The maximum number of nuts/plant (887) and yield/plant (3.290 kg) were observed in plants spaced at 10m x 5m rectangular system with 50 per cent thinning of plants followed by 8m x 8m square system (794, 3.009 kg) and 10m x 5m rectangular system (642, 2.497 kg). The minimum number of nuts/plant (372) and yield/plant (1.298 kg) were observed in 5m x 5m square system with 75 per cent thinning (to be thinned). As regard to yield per block the trees planted in 6m x 6m x 6m - triangular system, ranked first being 39.688 kg followed by 38.808 kg and 32.457 kg in 5m x 5m - square with no thinning and 5m x 5m - square with 75 per cent thinning (to be thinned) respectively and the same was minimum (6.304 kg) under 10m x 10m square system. The maximum cumulative yield per block for last four years (1983-92) was 180.97 kg in 5m x 5m square system while the same was 152.20 kg and 144.0 kg under 6m x 6m x 6m triangular system and 5m x 5m square system with 75 per cent thinning (to be thinned). The trees planted under 10m x 10m system recorded minimum cumulative yield/block (25.66 kg).

Table 41 Effect of spacing on yield of cashew (Jhargram)

Sl. No.	Treatments	No. of plants/ block	Canopy	No. of nuts/ plant	Yield/ plant (kg)	Yield/ block (kg)	Cumulative yield/ block 1988-92 (kg)
1.	5m x 5m square-no thinning	25	Medium	392	1.552	38.808	180.97
2.	5m x 5m square-50% -do-	13	-do-	447	1.805	23.476	90.53
3.	5m x 5m square-75% -do-	25	-do-	372	1.298	32.457	144.00
4.	10m x 5m rectangular	8	-do-	642	2.497	19.979	94.58
5.	10m x 5m rectangular-50% thinning	4	-do-	887	3.290	13.163	42.23
6.	10m x 10m square	4	-do-	409	1.591	6.364	25.66
7.	10m x 10m x 10m triangular	7	-do-	416	1.901	13.307	45.02
8.	8m x 8m square	9	-do-	794	3.009	27.083	136.08
9.	8m x 8m x 8m triangular	12	-do-	463	1.662	19.940	92.83
10.	6m x 6m square	16	-do-	548	2.027	32.441	136.12
11.	6m x 6m x 6m triangular	22	-do-	507	1.804	39.688	152.20
12.	5m x 5m square-selective thinning	13	-do-	426	1.559	20.316	104.05
	SEM (+)	-	-	44.809	0.137	3.022	
	CD at 5%	-	-	130.777	0.402	8.821	

VENGURLA

This trial has been initiated in July 1990 and is at initial stage. The gaps observed have been filled, the growth parameters have been recorded. The yield of nuts will be recorded from the fruiting season of 1994.

Agr. 5: Standardization of index leaf in Cashew
(Bapatla)

BAPATLA

The main objective of this experiment is to standardize the index leaf in cashew for chemical analysis and foliar diagnosis to judge the nutritional status. For this purpose, third, fourth, fifth and sixth leaves starting from the top of a crown were collected from all the four sides of a tree at different stages, i.e.,

1. Before fertilizer application
2. 15 days after fertilizer application
3. 30 days after fertilizer application
4. 60 days after fertilizer application
5. Before flowering
6. Flowering and nut formation
7. Advanced fruiting stage.

The fertilizer dose of 500g N, 125g P₂O₅ and 125g K₂O were applied as a single dose during the month of August. (Table 42).

From the data in Table 42 it is observed that the nutrient status in different leaves of a crown is varied. Nitrogen percent in third leaf is significantly high over the fourth leaf. Although the third and fourth leaves have recorded higher concentration of P, K, Ca and Mg nutrients, they are statistically on par with nutrient levels of other leaves.

The distribution of nutrients in the leaves during different stages of sampling showed a regular pattern. Leaf samples collected before fertilizer

Table 42. Nutrient composition in different leaves of a crown at various growth stages (Bapatla)

Leaf position	% N	% P	%K	% Ca	% Mg
Third leaf	1.86	0.254	0.724	0.361	0.240
Fourth leaf	1.82	0.260	0.720	0.362	0.236
Fifth leaf	1.70	0.185	0.644	0.310	0.198
Sixth leaf	1.65	0.182	0.652	0.294	0.214
SEM ±	0.045	0.008	0.032	0.024	0.006
CD at 5%	0.162	NS	NS	NS	NS
<u>Stages</u>					
Before fertilizer application	1.56	0.142	0.525	0.242	0.190
15 days after -do-	1.82	0.174	0.730	0.260	0.184
30 days -do- -do-	2.14	0.185	0.772	0.324	0.220
60 days -do- -do-	2.36	0.262	0.960	0.402	0.344
Before flowering	2.20	0.248	0.926	0.412	0.286
Flowering & nut formation	1.42	0.164	0.632	0.324	0.246
Advanced fruiting stage	1.18	0.122	0.450	0.280	0.184
S.Em ±	0.072	0.009	0.028	0.019	0.016
CD at 5%	0.425	0.038	0.084	0.062	0.055

application contained relatively low amount of nutrients, which increased upto fourth stage of sampling (i.e., 60 days after fertilizer application) and thereafter decreased. The lowest values of all the nutrients are noticed at advanced fruiting stage (Table 42).

Table 43. Correlation of yield with N, P, K, Ca and Mg contents of leaf (Bapatla)

Yield (kg/tree)	% N	% P	% K	% Ca	% Mg
12.6	1.76	0.192	0.79	0.40	0.18
9.7	1.60	0.160	0.62	0.26	0.20
14.5	2.38	0.215	0.90	0.38	0.24
10.2	1.68	0.184	0.64	0.32	0.17
13.4	1.82	0.280	1.24	0.40	0.22
9.8	1.68	0.162	0.56	0.34	0.19
8.9	1.54	0.178	0.70	0.26	0.17
13.8	2.10	0.225	0.81	0.28	0.26
8.2	1.40	0.156	0.58	0.24	0.24
11.5	1.96	0.220	0.84	0.32	0.20
r=	0.821	0.532	0.469	0.540	0.462
Table value: 'r' at 5% for '8' d.f. is 0.632					

The yield is correlated with leaf nutrients and presented in the Table 43. It is observed that the yield is positively correlated with leaf nutrient concentration of N, P, K, Ca and Mg. The correlation between yield and per cent leaf nitrogen is significant at 5 per cent level.

Agr. 6: Cashew based cropping system

(Bapatla, Bhubaneswar, Vridhachalam and Vengurla)

The objective of this experiment is to find out a suitable intercrop to be grown in the initial years of cashew orchard.

Experimental detailsPerennial crops

Bapatla, Bhubaneswar,
Vridhachalam and Ven-
gurla

Eucalyptus, casuarina,
subabul, acacia, mango,
melia and cashew.

Annual crops

Bapatla and Vridhacha-
lam Bapatla

Sesamum, cowpea, mus-
tard, horse gram and
bajra

Vridhachalam

Groundnut, blackgram,
cowpea and redgram

Spacing

Main crop

Cashew--8m x 8m

Intercrops

Mango and cashew--4mx
4m

Forest species--2mx2m

Design

RBD

Replications

Three

BAPATLA

Among the perennial intercrops Casuarina and Eucalyptus are coming up well. The growth of other intercrops is not satisfactory due to damage caused by cattle and human trespass.

All the annual crops were sown during the month of September 1992 with five replications, when there is enough moisture in soil. All these crops were grown under rainfed conditions. The soil is

completely sandy. No intercrop has come to maturity due to severe soil moisture stress in sandy soil during the crop season.

BHUBANESWAR

The trial with perennial crops was laid out during 1990. The height of Eucalyptus varied from 4.0 to 5.0m. The average height of cashew plants varied from 1.5 to 2.0 m.

VRIDHACHALAM

(i) With annual intercrops:

This trial was laid out under rainfed condition in an area of 1.5 acres using randomised block design during the month of August 1992. Annual intercrops of Co4, Cowpea, Co6 Redgram, Vemban 1 Blackgram and VRI-2 groundnut were raised in between VRI-2 cashew grafts during August 1992 (Rabi crop) replicated thrice. The yield recorded from different intercrops are furnished below:

1. Co4 Cowpea	9 kg/ha
2. Co6 Redgram	313 kg/ha
3. Vemban-1 Black gram	19 kg/ha
4. VRI-2 Groundnut	104 kg of dry pods/ha

In red gram intercropped area the growth of the cashew was found affected. Whereas the growth of cashew in the cowpea intercropping plot was found to be satisfactory even after the smothering growth of cowpea.

(ii) With perennial intercrops:

During the period under report, planting of various perennial intercrops viz., Acacia, subabul,

melea, casuarina and eucalyptus along with VRI-2 cashew as main crop was taken up during the month of February 1993, using randomised block design with three replications. Regular pot watering besides cleaning of plant basins were attended. Except eucalyptus and casuarina growth of all other intercrops and cashew was found satisfactory. Gap filling in the above perennial crop will be taken up during the month of July 1993. Arrangements have been made to procure mango grafts for taking up planting in this trial during July 1993.

VENCURLA

The data regarding the growth and yield recorded during the fruiting season of 1992-93 has been presented in Table 44. It was found that the intercrops with forest species like Australian acacia and Subabul have adversely affected the growth as well as yield of main crop cashewnut. The other species like eucalyptus and casuarina had marginally affected the yield of main crop. Amongst the forest species, eucalyptus showed the maximum height (11.50 m).

Table 44 Intercropping in cashewnut (1992-93) (Vengurla)

Treatments (intercrop)	Main crop				Intercrops			
	Height (m)	Girth (cm)	Volume (cub.m)	Yield nut/tree (kg)	Yield nut/ha (kg)	Height (cm)	Girth (cm)	Light intensity (LUX)
Nimbara (Melia sp.)	3.53	40.33	76.79	1.19	238.00	6.25	21.6	30.57
Sucalyptus Australiana	3.32	38.83	87.60	1.74	348.00	11.50	42.5	36.23
Subabul	3.80	31.63	55.86	0.67	134.80	9.25	43.8	18.73
Casuarina	3.26	29.60	40.16	0.58	116.60	8.20	43.0	27.78
Cashewnut*	3.78	46.66	100.98	1.45	290.00	8.50	33.5	37.32
Mango	3.28	36.00	63.14	1.26	787.50	4.80	41.0	36.40
Control	2.95	43.08	104.83	1.57	315.00	2.20	26.7	36.51
	3.26	40.13	120.51	2.18	436.30	-	-	-

*625 plants/ha (4x4m spacing) of cashewnut

II. CROP MANAGEMENT**B. HORTICULTURE**

Hort. I: Vegetative propagation trial

(Bapatla, Bhubaneswar, Chintamani, Jhargram,
Madakkethara, Vridhachalam and Vengurla)

The objective of the Project is to find out suitable grafting method and best month for cashew propagation under different agroclimatic conditions.

Grafting methods tried:

1. Softwood grafting
2. Veneer grafting
3. In situ grafting
4. Flush grafting

BAPATLA

The trial was taken up to find out the best method and month of vegetative propagation under Bapatla conditions.

Treatments

- | | |
|-----------------------|--|
| 1. Soft wood grafting | 45 days old root stock
90 days old scions |
| 2. Veneer grafting | 60 days old root stock
90 days old scions |
| 3. Flush grafting | 45 days old root stock
21, 28, 35 & 42 days old
scions |

The percentage of success in soft wood grafting and veneer grafting methods of propagation are presented in Table 45.

A. Softwood grafting: Soft wood grafting was done from July 1992 to March 1993. Highest percentage of

Table 45. Percentage of success in soft wood and veneer grafting methods (Bapatla)

Sl. No.	Month	Soft wood grafting		Veneer grafting		Temperature		Humidity	
		No. made	su- ccess %	No. made	su- ccess %	Max.	Min.	AM	PM
1.	Jul. 92	200	78	39.0	-	35.6	26.1	72	57
2.	Aug.	200	74	37.0	-	33.6	25.1	77	67
3.	Sep.	2000	1004	50.2	54	32.7	24.7	83	73
4.	Oct.	2000	1150	51.5	62	32.7	23.8	82	73
5.	Nov.	2000	1242	52.1	85	29.7	21.9	90	78
6.	Dec.	2000	1456	72.8	82	28.8	16.8	90	60
7.	Jan. 93	2000	1470	73.5	60	29.6	16.8	93	65
8.	Feb.	2000	1235	61.75	86	30.7	17.9	88	70
9.	Mar.	2000	1120	50.6	62	32.6	22.4	85	65
				r values:		-0.908		0.482	
						-0.852		0.479	
						SMG			
						VG			

success was recorded in the months of December (72.8), January (73.5) and February (61.7).

B. Veneer grafting: The percentage of success in veneer grafting was poor when compared to soft wood grafting. Maximum percentage of success was recorded in the months of November (28.3), December (26.3) and February (28.6).

Both the methods of propagation have recorded maximum success during the months from December to February. During these months the maximum temperature was around 30°C and relative humidity was about 90 per cent.

C. Flush grafting: Flush grafting was done using 21, 28, 35 and 42 days old flushes with 45 days old root stock during October to January and results are presented in Table 46. Flush grafting was tried under partial shade condition and in mist-chamber made of bamboo frame covered with polythene sheet. The percentage of success in both the treatments was poor.

Maximum success of 20-34 per cent was recorded during the months of November and December under mist condition. Comparatively the percentage of success under mist was higher than partial shade condition.

Among the three methods of propagation it was concluded from the above results that soft wood grafting is the ideal method under Bapatla conditions during the months from November to February.

Table 46. Percentage of success in flush grafting (Bapatla)

Sl. No.	Month	Age of scion (days)	Under Mist			Under partial shade		
			No. made	No. suc- cess	% suc- cess	No. made	No. suc- cess	% suc- cess
1.	Oct.92	21	100	15	15	100	22	22
		28	100	23	23	100	16	16
		35	100	16	16	100	12	12
		42	100	18	18	100	14	14
2.	Nov.92	21	100	-	-	100	-	-
		28	100	18	18	100	12	12
		35	100	29	29	100	18	18
		42	100	32	32	100	16	16
3.	Dec.92	21	100	22	22	100	16	16
		28	100	20	20	100	19	19
		35	100	34	34	100	18	18
		42	100	18	18	100	15	15
4.	Jan.93	21	100	-	-	100	-	-
		28	100	-	-	100	-	-
		35	100	24	24	100	10	10
		42	100	18	18	100	8	8

BHUBANESWAR

Soft wood grafting was carried out from April, 1992 to March 1993. The highest graft success was recorded in the month of September, 75.0 per cent, followed by August 68.23 per cent, July 58.0 per cent and May 50.5 per cent. Minimum success was recorded in January 15.0 per cent (Table 47).

Table 47 Vegetative propagation trial (Bhubaneswar)

Sl. No.	Month	No. of grafts made	Successful gr-afts		Temperature (°C)		Humidity	
			No.	%	Max.	Min.	Max.	Min.
<u>1992</u>								
1.	Apr.	100	37	37.0	36.7	23.7	86	44
2.	May.	400	202	50.5	36.3	25.5	87	60
3.	Jun.	120	52	43.3	35.4	26.4	89	64
4.	Jul.	250	145	58.0	32.4	25.2	90	79
5.	Aug.	340	232	68.2	32.1	24.1	91	78
6.	Sep.	260	195	75.0	32.9	24.5	92	74
7.	Oct.	120	42	35.0	32.7	22.5	90	64
8.	Nov.	100	21	21.0	30.9	19.7	83	53
9.	Dec.	100	18	18.0	29.2	13.6	92	37
<u>1993</u>								
10.	Jan.	100	15	15.0	30.5	15.6	89	39
11.	Feb.	100	35	35.0	32.6	17.8	89	37
12.	Mar.	140	56	40.0	35.1	21.6	87	43

CHINTAMANI

The success obtained in soft wood grafting has been furnished in Table 48. It could be seen from the table that the percentage of success was maximum in the month of September (60.0%) followed by November and October (51.1 and 48.0%) respectively. The least success (16.0%) was in the month of January and in the remaining months it varied from 17.8 to 35.0 per cent.

Table 48. Percentage of success of soft wood grafting (Chintamani)

Month	No. of grafts made	Success-ful grafts		Temperatu-re (°C)		RH %
		No.	%	Max.	Min.	
Jun.	200	42	21.0	31.8	*	68
Jul.	191	34	17.8	31.6	*	67
Aug.	256	66	25.7	29.0	19.0	71
Sep.	238	143	60.0	30.6	19.6	69
Oct.	102	49	48.0	29.5	18.1	70
Nov.	170	87	51.1	28.5	16.6	69
Dec.	100	35	35.0	28.0	11.9	64
Jan.	100	16	16.0	28.3	17.3	52

* Not available

JHARGRAMa) Studies on success of soft wood grafting

To find out the optimum period for soft wood grafting, two months old seedlings of Cv. Red Hazari were used as root stock and scions were collected from BLA-39-4 variety. A good success of 59.0 per cent, 67.0 per cent and 63.0 per cent was recorded in the months of July, August and September respectively. The percentage of success was nil during the month of January and in the remaining months it varied from 4.0 per cent to 41.0 per cent (Table 49).

To determine the effect of low cost humidifier on success of soft wood grafting in comparison to ordinary condition, another set of soft wood grafts were made during the month of August to December, 1992. The low cost humidifier is a simple mosquito-net like structure constructed with bamboo and white polythene covering. The bottom sand inside the structure always kept moist through watering, due to which

Table 49. Percentages of success in soft wood grafting (Observations recorded 2 months after grafting) (Jhergrām)

SCION: ELA-39-4

Month of grafting	Under Ordinary condition		Under low-cost modifier		Temperature (°C)	Relative humidity (%)		
	No. of grafts made	% of successful grafts	No. of grafts made	% of successful grafts		Max.	Min.	AM
Mar. 92	50	8	16.0	-	34.1	20.2	82.0	48.0
Apr.	50	6	12.0	-	34.3	23.5	78.8	51.0
May.	50	11	22.0	-	36.6	24.3	80.6	53.1
Jun.	360	123	41.0	-	34.0	25.2	83.4	63.4
Jul.	300	177	59.0	-	32.2	25.0	88.5	80.8
Aug.	300	201	67.0	74	31.4	25.3	87.9	83.0
Sep.	300	189	63.0	771	31.7	25.8	84.9	80.6
Oct.	300	105	35.0	46	31.2	26.6	84.5	68.3
Nov.	150	21	14.0	17	30.3	17.5	84.5	56.3
Dec.	150	6	4.0	11	26.4	11.8	81.5	53.0
Jan. 93	100	-	-	-	25.9	12.6	76.7	46.4
Feb.	100	18	18.0	-	30.0	15.0	72.2	36.5
Mar.	100	*	*	-	32.2	18.8	71.4	36.7

*Establishment percentage yet to be recorded.

the relative humidity inside the structure increased. It is revealed from the table that low cost humidifier had definite beneficial effect on graft production. Under low-cost humidifier, the percentage of success was 74.0, 71.0 and 46.0 per cent respectively during the months of August, September and October, which is comparatively higher than under ordinary condition of the same period.

b) Studies on success of In-situ grafting in cashew

This trial was conducted during the month of June to November 1992 and the observation recorded on percentage of success is furnished in Table 50. Soft wood grafting method was followed. As per programme, the requisite seedlings have already been raised monthwise since June 1991. Cashew seeds of Cv. Red Hazari were sown at the rate of two seeds/pit and allowed to grow for one year and scions were collected from BLA-39-4 variety. Highest establishment of 68.0 per cent was observed during the month of June followed by August (64.0%), July (60.0%) and September (56.0%).

Table 50 Percentage of success in In-situ grafting (Jhargram)
Age of root stock: One year Scion:BLA-39-4

Month of grafting	No. of grafts made	No. of successful grafts	% of success
Jun. 92	50	34	68.0
Jul.	50	30	60.0
Aug.	50	32	64.0
Sep.	50	28	56.0
Oct.	50	19	38.0
Nov.	50	4	8.0
Dec.	50	-	-

MADAKKATHARAFlush grafting in Cashew

Five trees were beheaded each month and flushes of 7 and 14 days old were grafted on 21 days old root stock. The data are furnished in Table 51.

The success percent was very low in the case of flush grafting with 7 and 14 days old induced flushes. A maximum of 27 per cent success could be obtained by inducing flushes on trees beheaded during June, 1992. The flushes produced after the beheading were very lanky and this may be the reason for low success percentage.

Table 51. Success percentage of flush grafting as influenced by time of beheading (Madakkathara)

Month of beheading	Month of grafting	Age of flushes (days)	No. of grafts made	Successful grafts		Temperature (°C)		Relative humidity
				No.	%	Max.	Min.	
Mar. 92	Apr. 92	7	100	5	5	36.9	22.8	61
		14	100	6	3	30.3	24.4	73
Apr. 92	May. 92	7	100	6	6	36.3	24.4	65
		14	100	20	20			
May. 92	Jun. 92	7	100	18	18	33.8	24.8	73
		14	100	25	25			
Jun. 92	Jul. 92	7	100	12	12	30.1	23.7	64
		14	100	27	27			
Jul. 92	Aug. 92	7	100	13	13	28.8	22.7	87
		14	100	24	24			
Aug. 92	Sep. 92	7	100	12	12	28.9	23.3	88
		14	100	23	23			
Sep. 92	Oct. 92	7	100	13	13	30.1	23.1	82
		14	100	24	24			
Oct. 92	Nov. 92	7	100	1	1	30.7	22.9	82
		14	100	1	1			
Nov. 92	Dec. 92	7	100	1	1	31.0	23.1	77
		14	100	5	5			

Table (ctd...)

(Table ctd....)

Dec.92	Jan.93	7	100	0	0	31.1	22.3	61
		14	100	4	4			
Jan.93	Feb.93	7	100	1	1	32.6	20.7	53
		14	100	6	6			
Feb.93	Mar.93	7	100	2	2	34.1	22.0	62
		14	100	5	5			

VRIDHACHALAM

Studies will be continued with soft wood grafting, veneer grafting and flush grafting and the data correlated with weather factors. In addition, new trials on in situ grafting by soft wood and side grafting will be initiated.

Softwood grafting

The trial was continued for the third year using 30, 60 and 90 days old scion and graft prepared on each age groups of 10, 15, 20, 25, 30, 40, 50 and 60 days old root stock seedlings adopting soft wood grafting method at monthly intervals between July 1991 and March 1992. The data on the establishment of grafts on 60th day for the above period was analysed and the same presented in Table 52.

It is observed that highest establishment of grafts was found using 90 days old scion of VRI-2 on both 25 days and 30 days old seedlings (root stock) registering 90.9 per cent as compared to 73.3 to 83.3 per cent and 63.3 and 73.3 per cent for 60 and 30 days old scions respectively. Among the months, November registered the highest mean establishment of 67.50 per cent.

Veneer grafting:

The trial using 30, 60 and 90 days old scion of VRI-2 on 90, 120 and 150 days old root stock seedling was conducted adopting veneer grafting at monthly intervals from July 91 and continued upto January 92. The establishment of grafts on 60th day after grafting was got analysed and presented in Table 53.

Table 53. Establishment of grafts by veneer grafting at different months
(Vridhachalam)

Age of root stock	Age of scion	Months									
		Jul.91	Aug.91	Sep. 91.	Oct.91	Nov.91	Dec.91	Jan.92			
90	30	10.0	13.3	20.0	23.3	16.7	16.7	16.7	20.0	16.7	16.7
	60	16.7	16.7	30.0	26.7	26.7	26.7	20.0	20.0	20.0	23.3
	90	16.7	26.7	33.3	40.0	46.7	46.7	30.0	30.0	30.0	30.0
120	30	13.3	16.7	26.7	23.3	26.7	26.7	30.0	30.0	30.0	16.7
	60	20.0	23.3	33.3	36.7	36.7	36.7	33.3	33.3	26.7	26.7
	90	30.0	30.0	36.7	43.3	56.7	56.7	40.0	40.0	36.7	36.7
150	30	23.3	23.3	33.3	30.0	30.0	30.0	30.0	30.0	30.0	20.0
	60	30.0	30.0	36.7	43.3	43.3	43.3	43.3	43.3	43.3	30.0
	90	36.7	32.3	43.3	53.3	63.3	63.3	46.7	46.7	40.0	40.0
	Mean	21.9	23.7	32.6	35.5	39.3	39.3	32.2	32.2	26.7	26.7

The highest survival of 63.3 per cent, was noticed using 90 days old scion on 150 days old seedlings against 30.0 and 43.3 per cent for 30 and 60 days old scion respectively during November. Among the months, the same November also recorded the highest mean establishment of 39.3 per cent closely followed by 35.5 per cent in October 1991 (Table 54)

Table 54. Establishment of grafts by veneer grafting (Vridhachalam)

Month	No. of grafts prepared	Successful grafts		Temperature (°C)		Humidity %	
		No.	%	Max.	Min.	FN	AN
Jul. 92	270	59	21.9	36.7	27.5	61	47
Aug.	270	70	25.9	38.3	25.3	74	59
Sep.	270	91	33.7	34.0	24.9	78	62
Oct.	270	119	44.1	34.9	25.2	81	70
Nov.	270	98	36.4	34.1	24.4	85	72
Dec.	270	100	36.9	31.3	25.3	80	70
Jan. 93	270	100	37.0	34.5	23.1	78	60

In situ soft wood grafting:

This new trial was initiated during this season by sowing of seeds directly in the field at monthly intervals from September 1992 and the grown up 45, 60 and 75 days old seedlings was used as root stock over which 30, 60 and 90 days scion of VRI-2 were used for grafting in situ by soft wood grafting method. The grafting initiated between November, 1992 and January 1993 indicated the highest graft survival of 88.0 per cent using 90 days scion of VRI-2 on 60 days old seedlings in November 1992, besides recording the highest mean establishment of 62.4 per cent in the same month.

Flush grafting:

This trial was repeated using 28, 35, 42 and 49 days old terminal flushes (scion) of VRI-2 and grafted individually on 14, 21, 28, 35 and 42 days old seedlings adopting soft wood grafting method in September 1992. The prepared grafts were kept for establishment in mist (having a humidity of 85 to 90%) and partial shade (having humidity of 60 to 70%) separately and the data on sprouting and establishment of grafts recorded. The number of days taken for sprouting under mist condition was earlier in different treatments ranging between 7 to 11 days as against 10 to 14 days under partial shade condition (Table 55). The data on the establishment of grafts on 60th day was analysed and the same presented in Table 56. It is found that 42 days old scion grafted on 35 days old root stock seedling recorded the highest establishment of 73.5 per cent as compared to 60.2 per cent observed under partial shade condition. However, the trial conducted in 1991 showed the highest establishment using 35 days old scion grafted on 35 days root stock. In general, higher per cent of establishment was noticed in mist condition under different treatments as compared to partial shade condition. There was significant difference between scion, root stock and environment besides their two way interactions.

VENGURLA

The grafting operation was performed in the month of November 1992 (flush grafting). During the period November-December the maximum temperature varied from 32.9°C to 33.7 °C and minimum temperature from

Table 55. Sprouting and survival of grafts by flush grafting in September 1992
(Vridhichalam)

Age of root stock (days)	Age of scion	No. of grafted	No. of days taken for sprouting	No. of days taken for sprouting		No. of grafted	No. of grafted	No. of grafted	No. of grafted
				Mist	Partial shade				
14	28	30	11	8	26.7	14	6	20.0	
	35	30	11	10	33.3	14	7	23.3	
	42	30	10	5	16.7	13	3	10.0	
	49	30	10	6	20.0	13	3	10.0	
21	28	30	9	10	33.3	13	7	23.3	
	35	30	9	16	53.3	12	8	26.7	
	42	30	9	14	46.7	12	10	33.3	
	49	30	9	12	40.0	12	8	26.7	
		28	30	9	14	46.7	12	9	30.0
28	35	30	8	16	53.3	11	9	30.0	
	42	30	8	14	46.7	12	11	36.7	
	49	30	8	12	40.0	11	8	26.7	
		28	30	8	10	33.3	11	9	30.0
35	35	30	8	18	60.0	11	15	50.0	
	42	30	7	24	80.0	11	20	66.7	
	49	30	8	18	60.0	11	14	46.7	
		28	30	8	10	33.3	11	9	30.0
42	35	30	7	17	56.7	10	12	40.0	
	42	30	8	20	66.7	10	13	43.3	
	49	30	8	15	50.0	11	8	26.7	

Table 56. Establishment of grafts on 60th day by Flush grafting method September, 1992 (Vridhachalam)

Age of seedlings	Environment	Age of scion			
		28 days	35 days	42 days	49 days
14 days	Shade	46.7(43.1)	53.3(46.9)	63.5(52.8)	60.0(50.8)
	Open	36.5(37.2)	46.7(43.1)	50.0(45.0)	43.2(41.1)
21 days	Shade	46.7(45.0)	50.0(45.0)	66.8(54.8)	63.5(52.8)
	Open	36.5(37.2)	46.7(43.1)	53.3(46.9)	46.7(43.1)
28 days	Shade	36.5(37.2)	43.2(41.1)	56.8(48.9)	46.7(43.1)
	Open	30.0(33.2)	33.2(35.2)	40.0(39.2)	36.5(37.2)
35 days	Shade	23.2(28.8)	43.2(41.1)	73.5(59.0)	66.8(54.8)
	Open	16.4(23.9)	26.5(31.0)	60.2(50.9)	36.5(37.2)
42 days	Shade	26.5(31.0)	36.5(37.2)	70.0(56.8)	66.8(54.8)
	Open	20.0(26.6)	40.0(39.2)	63.5(52.8)	43.2(41.1)

Figures in parantheses represents angular values)

20°C to 20.7°C. It was observed from the data (Table 57) that 21 to 42 day old root stock when grafted with 28 to 42 day old scion flush, recorded higher success after 90 days from grafting..

Table 57. Flush grafting in cashew, 1993 (Vengurla)

Root stock age	Age of scion flush				Average
	21 days	28 days	35 days	42 days	
14 days	61	80	74	65	70.00
21 days	85	87	85	83	85.00
28 days	88	85	82	90	86.25
35 days	81	80	85	85	82.75
42 days	66	79	84	88	79.25
Average	76.2	82.2	82.2	82.2	

Hort. 3: Top working trials in cashew

(Bapatla, Bhubaneswar, Jhargram, Madakkathara
Vridhachalam and Vengurla)

The main objective of this experiment is to rejuvenate the unthrifty cashew trees.

Age of the top worked trees	Below 5 years
	5-10 years
	10-15 yrs.
	15-20 yrs.
Height of beheading	0.5m and 1.0m

BAPATLA

Top working was done during the months of October, November and December 1992 on 12 year old cashew trees. Beheading of cashew trees was done at 1.0m and 1.5m. Five trees were beheaded in each treatment. The cut ends of the stumps were swabbed with Blitox and BHC paste. The scion material from BPP-6 was used for grafting. Soft wood grafting method was used on 30 days old shoots after sprouting and the results are presented in Table 58.

Results presented in Table 57 revealed that beheading the trees during November-December at 1 m height and grafting during January-February which showed 60-80 per cent of success was found suitable for top working under Bapatla conditions.

BHUBANESWAR

5-10 years old plants were beheaded during May, June, and July. The grafting operations was carried

Table 58. Top working trial at Bapatia

Age of trees	Height of beheading	Month of heading	No. of trees beheaded	No. of trees survived	Month of grafting	No. of shoots grafted	No. of successful grafts	% of success
12 Years	1 m.	Oct.	5	5	Dec.	20	10	50
	1 m.	Nov.	5	5	Jan.	20	16	80
	1 m.	Dec.	5	5	Feb.	20	12	60
12 Years	1½m.	Oct.	5	5	Dec.	20	10	50
	"	Nov.	5	5	Jan.	20	9	45
	"	Dec.	5	5	Feb.	20	8	40

out on the newly emerged shoots in the month of July, August and September. The percentage of success varied from 60.0 to 84.0 per cent. Highest percentage of graft success was recorded in the plants beheaded in the month of June compared to May and July. (Table 59)

Top working trial was conducted during 1989. 5-10 year old trees were found suitable for top working. The yield data for three year old top worked trees ranged between 0.5 to 1.25 kg/tree.

JHARGRAM

Top working trial was carried out during the months of August to December, 1992 on 10 year old trees at the beheading height of 1.0 m (Cv. Red Hazari). Out of 25 beheaded trees 19 trees were survived. Beheading during July 1992 followed by grafting during the month of September 1992 recorded the highest success of 25.0 per cent (Table 60).

Table 60. Top working trial in cashew (Jhargram)
Age of tree: 10 yrs. Height of beheading: 1.0m

Month of beheading	No. of trees beheaded	No. of trees survived	Month of grafting	No. of shoots grafted	No. of successful grafts	% of success
Jun.92	5	4	Aug.	26	6	23.07
Jul.92	5	3	Sep.	20	5	25.00
Aug.92	5	4	Oct.	30	6	20.00
Sep.92	5	5	Nov.	34	4	11.76
Oct.92	5	3	Dec.	22	-	-

Table 59. Top working trial in cashew (Bhubaneswar)

Age of the tree	Height of beheading (m)	Month of beheading		No. of trees beheaded	No. of trees survived	Month of grafting			Successful grafts	
		ng	ng			ed	ed	ed	No.	Per cent
5-10	0.5	May	5	5	5	Jul.	35	21	60.0	
		Jun.	5	5	5	Aug.	32	26	81.3	
		Jul.	5	5	4	Sep.	32	22	68.8	
	1.0	May	5	5	5	Jul.	40	29	72.5	
		Jun	5	5	4	Aug.	25	21	84.0	
		Jul.	5	5	5	Sep.	35	25	71.4	

MADAKKATHARA

A large plot trial on top working consisting of 53 trees were taken up during 1991. Timely plant protection measures were adopted to control the attack of tea mosquito and stem borer. The observations recorded are furnished in Table 61.

Maximum girth was recorded for Tree No.1034 (13.3 cm) followed by Tree No.995 (10.3 cm). A maximum of 5 primary branches were noticed on Tree No.1021. The spread was more in the case of Tree No.1034 (EW-165 cm, NS-150 cm). Number of panicles/m² was highest on Tree No.1004 (6) and the number of nuts per panicle was highest on Tree No.1001 (7). The harvesting is being continued.

Table 61. Growth and flowering characters of top worked trees during second year after top working (Madakkathara)

Tree No.	Girth (cm)	No. of primary branches	Spread (cm)		No. of panicles per sq.m.	No. of nuts/panicle
			East-West	North-South		
1028	9.2	4	90	185	3	4
1029	5.5	2	25	40	2	2
1034	13.3	3	165	150	5	6
995	10.3	3	75	90	4	5
1016	5.0	1	15	25	2	3
1021	9.2	5	120	100	4	3
1042	7.2	4	110	75	3	5
1015	7	1	15	20	3	2
1014	6	1	40	65	2	1
1037	4	1	32	29	1	1
1027	7.2	4	110	75	3	4
1001	9.6	3	165	110	4	7
1011	8.5	4	165	110	5	6
999	9	4	55	90	3	3
988	8	3	75	70	4	3
990	6.3	3	110	35	3	2
993	8	3	155	110	4	5
1004	9.6	3	145	170	6	4
982	7.7	4	160	135	5	3

VRIDHACHALAM

Based on the findings a demonstration plot using 50 trees were beheaded and subsequently grafted with scion of VRI-2 to study the growth and yield performance. The grafts were found dried due to prevalence of high temperature and higher incidence of stem borer after the grafting months.

VENGURLA

Top working was carried out in four different age group of trees (below 5, 5-10, 10-15 and 15-20) during 1988 and found that 5-10 year old trees are suitable for rejuvenation by top working and produced good yield.

During the fruiting^{season} of 1992-93, 10 trees (top worked) were reserved for recording the yield. Five year old top worked trees of Vengurla-4 variety has produced an average yield of 5.25 kg nuts/tree with a maximum yield of 9.20 kg nuts/tree.

Port. 4: Screening of root stocks for dwarfing characters

(Madakkathara and Vengurla)

The objective of the trial is to identify dwarfing characters in cashew, screening of root stocks at nursery stage based on morphological, anatomical and physiological characters like height, girth, number of stomata, bark percentage and phenolic contents.

MADAKKATHARA

Seeds collected from ten less vigorous types and five vigorous types were utilised for the study during 1992-93. While conducting the field survey in Palakkad and Kollam districts three less vigorous types could be identified. The seeds collected from these locations and two less vigorous Panama types were included for the study. The added types are:

1. Kariarapatta (Palakkad district)
2. Kottarakkara-1 (Kollam district)
3. Kottarakkara-2 (Kollam district)
4. P-3-2 (Panama type)
5. P-6-2 (Panama type)

The morphological and anatomical characters of the seedlings at nursery stage were studied. The data are given in Table 62.

VENGURLA

The seedling raised from seednuts of dwarf and vigorously growing trees were screened for morphological and anatomical characters at nursery stage. The

Table 62. Growth and anatomical characters of less vigorous and vigorous types (Medakkathara)

Variety/type	No. of nuts	Mean nut wt. %	Germi- nation (cm)	Hei- ght (cm)	Gir- th (cm)	No. of leaves	Inter- nodal leng- th (cm)	No. of stoma- ta/cm	Bark cent- Stem Root	per- cent	Phenol (ppm)	So- dium	Bark es	of sh- oot tip
<u>Less vigorous types</u>														
T.No.2286	20	5.9	73	24.8	2.4	5.5	2.2	373	18.8	29.8	27	31	31	31
UL-8-2	20	5.3	75	25.9	2.3	7.5	2.3	318	17.8	33.7	28	33	33	33
UL-10-2	28	5.0	81	16.6	1.9	6.5	1.7	213	17.9	31.2	32	32	32	32
T.No.2273	20	4.8	80	23.3	2.2	5.0	2.6	232	20.1	30.6	46	44	44	44
T.No.2021	20	5.5	79	21.2	2.6	5.5	2.1	315	14.5	31.0	25	39	39	39
Kariarapatta	5	5.0	68	20.3	2.4	6.5	2.1	337	13.3	24.8	27	36	36	36
Kottarakkare-1	5	5.0	60	21.8	2.2	6.0	2.6	282	15.1	26.9	27	31	31	31
Kottarakkare-2	6	6.0	62	16.8	1.7	7.5	1.6	228	11.8	30.2	34	31	31	31
P-3-2(Panama)	10	7.0	59	22.0	1.6	6.0	3.5	246	17.3	29.9	28	31	31	31
P-6-2(Panama)	5	11.0	55	20.3	2.0	7.0	3.5	264	12.2	32.4	26	29	29	29
<u>Vigorous types</u>														
K-22-1	20	6.0	85	23.8	3.1	7.5	3.5	391	10.2	23.7	27	26	26	26
H-1591	20	10.2	89	26.8	2.7	6.0	4.1	446	10.5	23.1	28	29	29	29
H-1610	20	8.9	82	30.1	2.8	7.0	3.6	418	9.5	22.3	24	28	28	28
K-10-2	20	8.3	93	24.2	2.4	8.5	3.8	391	10.1	21.8	29	28	28	28
H-1600	20	8.0	82	25.6	2.3	7.0	3.7	428	9.8	22.3	33	28	28	28

root stock did not show much difference in height, girth, stomatal count and total phenol content. As per the recommendation of Group Discussion, the grafts prepared on such root stocks (dwarf and vigorous) have been planted in the field during August, 1992. The growth parameter like height has been recorded and presented in Table 63.

Table 63. Root stock screening for dwarfing in cashew-nut (Vengurla)

Sl. No.	Root stock	Initial height (cm)	Final height (cm)	Increase in height (cm)
1.	VGL-1	28.20	52.33	24.13
2.	VGL-2	32.40	59.00	26.6
3.	VGL-3	38.80	64.00	25.2
4.	VGL-4	29.40	65.75	36.35
5.	VGL-5	32.20	54.00	21.8
6.	H-2/15	32.20	51.25	19.05
7.	T-40	33.20	67.60	34.40
8.	M-44-3	29.80	52.50	22.70
9.	H-1600	26.00	49.60	23.60
10.	VTH 59/2	34.40	54.75	20.35
11.	H-2/16.	31.20	70.25	39.05
12.	T-179	26.20	48.00	21.80
13.	H-26 (1603)	31.20	61.25	30.05
14.	H-1510	36.80	54.80	18.00
15.	VTH 20/4	34.40	74.75	40.35
16.	M-26-2	31.40	63.75	32.35

III. CROP PROTECTION

Ent. I. Chemical control of pest complex in cashew

The objective of the trial is to find out an effective insecticide for control of major and minor pests

Treatments (Old)

1. Endosulfan	0.05%
2. Quinalphos	0.05%
3. Monocrotophos	0.05%
4. Carbaryl	0.1%
5. Methyl parathion	0.05%
6. Phosalone	0.01%
7. Dimethoate	0.05%
8. Control	

Time of application: Three sprays coinciding with flushing, flowering and fruiting stages

Design: RBD

Replications: Three

Modified treatments

The treatments were modified in the National Group Discussion of Cashew Research Workers held at CPCRI Kasaragod during 1991 and the recommended treatments are as follows:

T-1	Monocrotophos (0.05%) one spray at flushing stage
T-2	Endosulfan (0.05%) one spray at flowering stage
T-3	Carbaryl (0.1%) one spray at fruiting stage
T-4	T-1 and T-2
T-5	T-1, T-2 and T-3

T-6	T-1 and T-3
T-7	T-2 and T-3
T-8	Control

Expt. 1: Control of major pests - Tea mosquito
(Chintamani, Jhargram, Madakkathara, Vridhachalam and Vengurla)

CHINTAMANI

Three sprays were given at the time of flushing, flowering and fruiting stages. Observations on the incidence of tea mosquito before spray and 30 days after spray were recorded and presented in Table 64. The incidence of tea mosquito was non-significant among treatments in pre-treatment count. Least incidence of tea mosquito (0.11%) was noticed in T-1 followed by T-4, T-5 and T-6 (0.13, 0.13 and 0.14 respectively) and were significantly superior over other treatments 30 days after first spray. Least incidence of tea mosquito was noticed in T-5 (0.11%) followed by T-4 (0.12), T-7 (0.15) and T-2 (0.15) which were significantly superior over other treatments, 30 days after second spray. In 30 days after third spray, the least incidence was noticed in T-5 (1.34%) followed by T-7 (1.59) and T-6 (2.25) and were significantly superior over other treatments. The incidence of tea mosquito was very low due to very low temperature during November and December. The parasites and predators were noticed.

Table 64. Percent incidence of tea mosquito in different treatments before and 30 days after each spray (Chintamani)

Treatments	Pretreat- ment cou- nt	After		
		1st sp- ray	2nd sp- ray	3rd spray
T-1 (one spray at flu- shing stage)	0.37	0.11	0.54	18.05
T-2 (one spray at flo- wering stage)	0.46	0.49	0.15	14.85
T-3 (one spray at frui- ting stage)	0.38	0.46	0.68	5.38
T-4, T-1 and T-2	0.42	0.13	0.12	15.43
T-5, T-1, T-2 and T-3	0.37	0.13	0.11	1.34
T-6, T-1 and T-3	0.39	0.14	0.28	2.25
T-7, T-2 and T-3	0.44	0.49	0.15	1.59
T-8 Control	0.38	0.47	0.77	19.23
SEm +	0.06	0.02	0.04	0.51
CD at 5%	NS	0.06	0.12	1.55

JHARGRAM

As per proforma of Section III in the last Proceedings of National Group Discussion of Cashew Research Workers (1951), the observations were recorded.

The modified treatment against tea mosquito were conducted and observations recorded at 30 days intervals after each treatment. The results presented in Table 65 revealed that Treatment-5 was significantly superior than all other treatments. It could be found during subsequent observations that same trend was maintained with regard to average percent of damage by tea mosquito. It has also been found that T-5 and T-6 after first spray,

Table 65. Incidence of tea mosquito in different treatments at Jhargram

	Pre-treat- ment count	Average percent of shoots/panicles/nuts da- maged 30 days after each treatment			Yield (kg/tree)
		First spray	Second spray	Third spray	
T-1	-	2.09(7.13)*	5.48(13.39)	11.94(20.06)	1.801
T-2	0.10	3.58(9.18)	8.66(17.00)	15.02(22.77)	1.649
T-3	0.11	3.90(11.28)	12.23(20.38)	7.72(16.06)	2.150
T-4	0.11	1.99(6.98)	7.05(13.75)	6.8(15.09)	2.276
T-5	-	0.93(3.87)	4.08(11.56)	2.08(8.09)	2.483
T-6	-	0.95(3.92)	8.18(16.60)	8.74(17.20)	2.015
T-7	0.9	2.76(9.55)	8.42(16.78)	7.23(15.53)	2.203
T-8	0.11	3.96(11.38)	12.37(20.48)	17.48(24.69)	1.562
LSD					
5%		2.145	3.98	3.03	
1%		2.977	5.52	4.20	
CV		9.91	9.91	9.91	

* Figures in parentheses indicate transformed values

T-5 and T-1 during second spray and T-5 and T-4 after third spray were found effective in controlling tea mosquito. The results during second and third spray indicated that the treatment difference were highly significant than untreated control. Maximum yield could be achieved in T-5, average yield 2.483 kg per tree could be obtained whereas 1.562 kg per tree in untreated control treatments.

It may be concluded that among 8 treatments tested, T-5 was found more effective followed by T-4, T-7 than all other treatments.

MADAKKATHARA

The old CYT (layer) plot was selected for the experiment. Two trees in each treatment were separated from the adjoining set of treatments by one set of guard trees all around. The guard trees were also sprayed (half portion of the canopy facing the treated trees) with the same insecticides of the respective treatments.

First spraying with monocrotophos (0.05%) was given during second week of November 1992 coincided with the flushing. The second and third sprays were given with endosulfan (0.05%) and carbaryl (0.10%) at the time of panicle emergence and fruit set stages during the months of December and January respectively as per the technical programme.

Observations on the incidence of tea mosquito, other minor pests viz., leaf miner, leaf roller, blossom webber etc., natural enemies and beneficial insects were recorded one day before spraying and one month after each spray.

All the species of ants and spiders present at the time of observation was counted in each quadrant. In the case of the predators, *Chrysopa* and mirid bug, four panicles from four different sides were inserted in polythene bags and brought to the laboratory and counted the immature stages and adults and represented as mean number per panicle.

The data is presented in Table 66. The occurrence of tea mosquito was comparatively low during November-December on shoots. After the first spray the mean per cent infestation was 23.48 in untreated control and in the other plots which have not received the first spray the mean percent, infestations were 12.50 (T-2), 14.15 (T-3) and 13.75 (T-7). In the plots that received first spray with monocrotophos tea mosquito infestation varied from 4.23 to 9.75 per cent. The mean score value on shoots after the first spray was 0.30 in untreated control. The mean score was reduced to 0.07 in monocrotophos treatment. After the first spray the panicle infestation was very low as compared to the untreated plots. Second spray with endosulfan 0.05 per cent was effective in reducing the panicle infestation. The level of infestation on panicle was very high in untreated control (43.36 per cent): In those treatments which did not receive any spray (T-3), 42.80 per cent panicle and 28.29 per cent tender nuts were affected by tea mosquito. Tea mosquito infestation was comparatively high towards the later stage of flowering and nut formation stages. Spraying at these stages could considerably reduce the tea mosquito incidence on nuts and panicles.

Table 65. Mosquito infestation in Experimental plots (Mean of three replications)
(Madakkathara)

Treat- ments	Pre-count		After first spray		After second spray		After third spray							
	Shoot Per Mean	cent score	Shoot Per Mean	Panicles Per Mean	Panicles Per Mean	nuts Per Mean	Panicles Per Mean	nuts Per Mean						
T-1	3.83	0.06	5.85	0.07	10.50	0.21	31.86	0.74	21.79	0.45	20.00	0.53	17.53	0.63
T-2	5.31	0.14	12.50	0.30	16.67	0.38	10.41	0.24	10.00	0.35	13.33	0.29	10.86	0.45
T-3	3.89	0.05	14.15	0.40	20.00	0.61	42.80	1.12	28.29	0.53	11.22	0.26	10.00	0.30
T-4	3.13	0.07	4.23	0.12	8.00	0.10	8.75	0.15	7.45	0.25	10.04	0.32	12.47	0.35
T-5	5.62	0.12	8.35	0.19	9.15	0.28	9.25	0.30	7.70	0.25	8.52	0.28	9.70	0.25
T-6	3.48	0.14	9.75	0.20	10.85	0.20	31.29	0.75	16.83	0.37	12.66	0.32	11.61	0.48
T-7	4.00	0.12	13.75	0.22	16.43	0.36	15.25	0.34	5.93	0.20	8.14	0.24	7.80	0.20
T-8	4.06	0.10	12.38	0.30	18.86	0.62	43.35	1.25	27.45	0.51	24.00	0.60	20.10	0.75

VRIDHACHALAM

An experiment on the control of tea mosquito bug with modified treatments in the Centre was conducted during 1992-93. Three sprays were given at flushing, flowering and fruiting phases. Observations on the incidence damage, score of damage and yield of nuts were recorded and furnished in Table 67.

Table 67. Mean incidence of tea mosquito bug in different treatments (modified treatments) (Vridhachalam)

Treatments	Pre count	Mean TMB population/quadrant			Mean Yield of 3 per count	
		First sprays	Second	Third		
T-1 (one spray at flushing)	0.0	1.0	0.77	1.0	0.92	1.710
T-2 (spray at flowering stage)	1.0	0.83	0.63	0.48	0.63	3.500
T-3 (spray at fruiting stage)	0.0	1.50	1.53	1.33	1.45	2.330
T-4, T-1 and T-2	0.0	1.00	1.25	1.23	1.16	3.500
T-5, T-1, T-2 & T-3	0.0	0.67	0.57	1.00	0.75	3.500
T-6, T-1 and T-3	0.0	1.43	1.23	1.00	1.22	4.620
T-7, T-2 and T-3	0.0	0.77	0.57	0.47	0.60	4.785
T-8 Control	0.0	3.00	2.53	3.13	2.89	1.975
CD					0.36	2.78

The results revealed that all the treatments were significantly superior to control in reducing the tea mosquito bug population per quadrant. Least tea mosquito bug population/quadrant of 0.60 was recorded in T-7 followed by T-2 (0.63). The highest yield of 4.785 kg/tree was registered in T-7 followed by T-6 (4.620/tree) while the control recorded the lowest yield of 1.975 kg/tree.

The results revealed that modified treatments tried were significantly superior to untreated control in controlling the tea mosquito bug damage. The lowest tea mosquito bug damage of 2.35 per cent was recorded in T-4 followed by T-2 (2.63%) and T-6 (2.9%). These treatments of T-4, T-2 and T-6 recorded 70.30, 70.34 and 67.18 per cent of TMB damage reduction over untreated control. The maximum tea mosquito bug damage of 8.84 per cent was recorded in untreated control (Table 68).

Table 68, Percent incidence of tea mosquito bug in different treatment (modified treatment before and 30 days after each spray) (Vridhachalam)

Treatment	Pre-treatment count	Per cent damage per quadrant			Mean Per cent of 3 nt re-counts (%)	Per cent reduction over control
		First sprays	Second sprays	Third sprays		
T-1 (one spray at flushing)	0.0 (4.05)	1.34 (7.18)	6.42 (15.20)	6.73 (15.50)	4.83 (12.63)	45.35
T-2 (one spray at flowering stage)	1.01 (6.58)	2.31 (8.55)	3.26 (9.70)	2.63 (8.93)	70.34	
T-3 (one spray at flushing stage)	0.0 (4.05)	3.34 (9.81)		8.07 (17.0)	6.49 (14.60)	26.58
T-4, T-1 & T-2	0.0 (4.05)	0.45 (5.43)	2.56 (8.81)	4.54 (11.9)	2.35 (8.71)	73.54
T-5, T-1, T-2 & T-3	0.0 (4.05)	4.35 (11.7)	9.66 (18.6)	10.86 (19.3)	8.29 (16.52)	6.22
T-6, T-1 & T-3	0.0 (4.05)	3.06 (8.84)	3.16 (10.8)	3.49 (11.2)	2.90 (10.27)	67.18
T-7, T-2 and T-3	0.0 (4.05)	3.63 (10.9)	5.66 (14.3)	6.80 (18.6)	5.36 (11.63)	39.36
T-8 control	0.0 (4.05)	2.92 (10.3)	9.60 (18.5)	14.00 (22.3)	8.84 (17.03)	-
CD Treatment			1.61			
Period			1.14			
Treatment x Period			NS			

Figures in parenthesis are transformed value

VENGURLA

The incidence of tea mosquito was recorded in 0-4 scale as under:

0	No lesions or streaks
1	Upto three necrotic lesions or streaks
2	4 to 6 coalescing or non-coalescing lesions or streaks
4	Lesions or streaks confluent complete drying of the affected shoots or panicles

Results were statistically non-significant 30 days after first and second sprays (Table 69). Because of the population build up of tea mosquito was observed only after third spray. Observations recorded 30 days after third spray indicated that the treatments T-2, T-4, T-7, T-6, T-3 and T-5 were observed to be significantly superior to T-8 (control) and at par with each other. However, the treatments T-2 and T-4 were significantly superior to T-1 also. The treatments T-7, T-6, T-3 and T-5 were at par with each other, while treatment T-1 was at par with control (T-8).

Table 69. Incidence of tea mosquito, Helopeltis antonii in different treatments (Vengurla)

Sl. No.	Treatments	Average per cent shoots/panicles damaged 30 days after sprays		
		1st spray	2nd spray	3rd spray
1.	T-1	2.22(4.05)	2.22(4.05)	6.62(14.64)
2.	T-2	0.00(0.00)	0.00(0.00)	3.39(10.39)
3.	T-3	0.69(2.76)	0.83(3.03)	4.41(12.02)
4.	T-4	0.00(0.00)	0.18(1.40)	3.54(10.81)
5.	T-5	0.37(2.01)	0.37(2.01)	4.60(12.10)
6.	T-6	0.00(0.00)	0.00(0.00)	3.98(11.48)
7.	T-7	1.29(6.29)	2.32(8.65)	3.96(11.31)
8.	T-8	0.57(3.51)	1.33(6.37)	7.92(16.26)
SE \pm		2.05	2.16	1.11
CD at 5%		NS	NS	3.37

Figures in parenthesis are arcsin values

Expt. 2: Control of minor pests

(Bapatla, Bhubaneswar, Chintamani, Jhargram,
Madakkathara, Vengurla and Vridhachalam)

BAPATLA

Clonal trees of 12 years age were selected for data recording at 10 days intervals by using 0.25 sq. m. frame in four quadrants on four sides. Three sprayings were given as per schedule. Data with reference to population of Lamida monocusalis, Myllocerus sp., % damaged laterals and nuts by fruit pests i.e., L. monocusalis, Nephopteryx sp. and Hipotima haligramma was recorded and is presented in Table 70. Incidence of Lamida monocusalis and Acrocercops syngamma during foliage was very negligible.

Among all the treatments, T-5 treated trees i.e., trees which received all the three sprays, first during flush, second during flowering and third during fruiting phase at 35-40 days interval with Monocrotophos 0.05% twice and carbaryl 0.1% third time, recorded less percentage infestation of Myllocerus sp. and Hipotima haligramma. Similarly, though the infestation of Lamida monocusalis on nuts and fruits was very less, it increased after 20 days of spraying with maximum decrease after 30 days of spraying in T-5 treated trees as well as minimum per cent infested nuts (5.05%) by Nephopteryx sp. The impact of three sprays (T-5) i.e., first at flush, second at penicle emergence and third at fruiting phases was clearly visible in recording maximum yields (18.835 kg/tree) followed by the trees sprayed with two sprays T-2 and T-3 (15.150 kg) in fruiting phase.

In confirmation with the 1991-92 results, same experiment was initiated during 1992-93. As the season

Table 70. Pest incidence/lateral during 1991-92 (Bapatla)

Treat- ments	Pre- treat- ment	Population of <u>Myllocerus</u>		Incidence of <u>H.haligramma</u>				II Post treatme- ntal count after						
		II		I		Pre-ti- eats tal co- unts		20 DAP						
		Post treatment- 10 days	Post-tri- eats tal count 10 days	Post treatment- 10 days	Post treatment- 20 days	30 days	% of	% of	% of					
T-1	1.0	4.7	3.8	2.2	3.3	0.6	0.3	6.4	2.8	15.0	10.4	3.1	3.5	4.0
T-2	1.0	2.0	10.3	7.2	6.0	3.1	2.7	9.6	9.6	11.7	11.9	6.3	5.9	3.0
T-3	2.3	4.7	9.3	7.7	10.0	4.3	2.9	13.3	7.3	12.4	11.5	4.7	4.7	3.7
T-4, 5	0.7	1.7	3.7	4.7	2.0	1.3	1.0	5.8	4.8	13.2	12.5	4.2	4.1	4.3
T-5	6.9	3.7	4.3	10.3	8.3	2.9	2.9	11.6	8.5	9.4	14.5	2.7	2.7	3.3
T-6	1.8	1.0	9.3	8.8	14.0	1.9	1.9	11.8	7.5	11.9	10.9	5.1	5.1	3.3
T-7	3.3	1.0	8.7	9.0	14.0	4.3	3.3	9.7	7.3	17.9	15.8	3.5	3.5	4.0
T-8 (Control)	4.0	3.0	12.3	7.8	12.0	5.2	4.1	9.3	5.7	12.9	14.0	3.1	3.1	4.0

H.h = Hipotima haligramma

STD = Shoot tips damaged

started very lately this year pre-treatmental counts were recorded by February 1993, followed by first spraying and thus post-treatmental counts. Pest incidence of Lemida monocusalis, Mylocerus sp. and Acrocercops syngramma were recorded. The experiment is in progress and will be concluded by May 1993. (Table 71).

Table 71. Pest incidence in fruiting season (Bapatla)

Treat- ments	% of damaged nuts by nut borer				% of ap- ple and nut borer	Yield in kg/ha
	Pre or- eatment	10 Days after spraying	20 Days after spraying	30 Days after spraying		
T-1	0.50	0.69	2.78	12.69	9.67	8.27
T-2	1.10	-	-	13.46	8.58	10.53
T-3	-	-	7.25	13.92	7.54	10.32
T-4	-	-	4.44	36.36	10.51	12.90
T-5	8.70	-	8.66	4.74	5.05	18.84
T-6	5.60	-	6.93	9.40	10.71	12.90
T-7	0.50	1.27	2.53	4.82	12.70	15.15
T-8	5.60	-	17.89	12.30	15.81	13.10

BHUBANESWAR

The modified treatments were carried out for control of minor pests as per the recommendation. Except shoot tip borers and flower thrips, the incidence of other minor pests was negligible. The insecticides used and the percentage of damage before and after spray is presented in Table 72. The incidence of shoot tip borer and inflorescence thrips were recorded 10, 20 and 30 days after each spraying. It is revealed from the data (Table 72.) that the percentage shoot damage by shoot tip borer ranged from 0.0 to 5.52 after 30 days of first spraying .

Table 72. Effect of different insecticides on shoot tip borer and inflorescence thrips incidence at Bhubaneswar

Treatments	% shoot infestation by shoot tip borer			*Mean thrips population/inflorescence						
	Pre treatment count	days after 1st spraying		Days after second spraying		Days after second spraying		Days after second spraying		
		10	20	30	10	20	30	10	20	30
	YT	BT	YT	BT	YT	BT	YT	BT	YT	BT
T-1	18.02	7.03 (2.60)	1.53 (1.22)	2.98 (1.81)	7.74 (2.84)	0.0 (0.7)	8.1 (2.92)	2.6 (1.7)	3.1 (1.9)	2.8 (1.8)
T-2	6.82	4.43 (2.00)	4.43 (2.00)	1.97 (1.45)	9.10 (3.00)	0.0 (0.7)	7.4 (2.8)	2.7 (1.8)	2.4 (1.7)	2.1 (1.5)
T-3	4.83	4.83 (2.29)	3.74 (2.05)	2.69 (1.74)	6.39 (2.60)	1.1 (1.1)	5.9 (2.5)	2.8 (1.8)	3.1 (1.9)	2.7 (1.8)
T-4	8.45	5.09 (2.31)	0.6 (0.7)	0.00 (0.70)	7.46 (2.7)	1.3 (1.2)	8.0 (2.9)	1.6 (1.4)	2.5 (1.7)	1.8 (1.5)
T-5	8.08	6.45 (2.62)	0.00 (0.7)	0.00 (0.70)	6.8 (2.7)	1.3 (1.2)	4.8 (2.3)	2.9 (1.8)	3.1 (1.9)	2.7 (1.8)
T-6	6.68	3.71 (2.04)	0.52 (0.94)	0.00 (0.70)	6.6 (2.7)	1.4 (1.3)	5.5 (2.4)	2.7 (1.8)	2.8 (1.8)	3.2 (1.9)
T-7	11.98	7.82 (2.87)	6.14 (2.54)	4.65 (2.23)	5.96 (2.5)	0.7 (0.9)	3.1 (2.8)	3.1 (1.8)	2.1 (1.6)	1.8 (1.5)
T-8	8.17	12.03 (3.37)	6.63 (2.61)	5.52 (2.23)	9.25 (3.1)	1.6 (1.3)	8.6 (2.9)	3.4 (1.9)	3.7 (2.0)	3.6 (2.0)
F Test		Sig.	Sig.	Sig.	N.Sig.	NS	NS	NS	NS	NS
S.E. (m) +		0.18	0.51	0.49						
CD(0.05)		0.38	1.09	1.04						

* Means of three replications. Figures in parentheses are $\sqrt{x + 0.5}$ transformed means

YT= Yellow thrips-Frankliniella schultzei Trybom.
BT= Black thrips Haplothrips Seyonicus Schumtz.

Table 73. Effect of different insecticides on inflorescence thrips incidence at Bhubaneswar

Treat- ments	*Mean thrips population/inflorescence							
	Days after third spraying							
	10		20		30		30	
	Yellow thrips	Black thrips	Yellow thrips	Black thrips	Yellow thrips	Black thrips	Yellow thrips	Black thrips
T-1	0.51(1.00)	1.02(1.22)	0.60(1.00)	0.41(0.95)	0.25(0.85)	0.18(0.82)		
T-2	0.16(0.80)	0.54(1.01)	0.26(0.87)	0.41(0.94)	0.40(0.94)	0.29(0.87)		
T-3	0.37(0.97)	0.64(1.06)	0.64(1.06)	0.72(1.16)	0.22(0.84)	0.33(0.91)		
T-4	0.33(0.88)	1.03(1.21)	0.49(0.97)	0.43(0.96)	0.40(0.95)	0.37(0.91)		
T-5	0.12(0.78)	1.68(1.45)	0.19(0.82)*	0.39(0.94)*	0.14(0.78)*	0.10(0.76)*		
T-6	0.39(0.91)	1.03(1.21)	0.43(0.96)	0.68(1.08)	0.34(0.91)	0.37(0.91)		
T-7	0.40(0.93)	0.41(0.93)	0.45(0.96)	0.55(1.02)	0.29(0.86)	0.54(0.99)		
T-8	1.37(1.36)	1.74(1.49)	1.11(1.21)	1.06(1.19)	0.81(1.11)	0.44(0.95)		

5 'F' test
S.E.(m)†
CD (0.05)

NS NS NS NS

NS

NS

NS

NS

Sig.

*Means of three replications Figures in parentheses are $\sqrt{x+0.5}$ transformed means

Yellow thrips: Franklirhelia schultzei G. & Loom.
Black thrips: Leocithrips curculionis Gahan

Significant difference was observed regarding percentage shoot infestation at 10, 20 and 30 days after first spray. The treatments which received the first spray with Monocrotophos (0.05%) showed the lowest percentage shoot infestation than the control. At 10 days after second spraying there was no shoot infestation at all by shoot tip borer. After second spray the incidence of yellow thrips and black thrips were not significant both at 10, 20, 30 days after second spray. However, the population of yellow thrips was least in T-7 as compared to other treatments. But the black thrips population was lowest in T-4 (which received both first and second spray) at 20 and 30 days after second spray. The population of inflorescence thrips (black thrips and yellow thrips) were less in all the treatments after third spray as compared to that after second spray. No significant difference was observed in inflorescence thrips incidence after third spray except the yellow thrips incidence at 10 days after third spray. At 10 days after third spray, lower incidence of yellow thrips (0.12/inflorescence) was observed in T-5 (which received all the three sprays). Similar observation was also recorded at 20 and 30 days after third spray regarding yellow thrips and black thrips incidence. (Table 73).

The natural enemies observed in the experimental plots were spiders (unidentified) mirid bugs and lady bird beetle. Among the insect pollinators black ants are predominant. The natural enemy population was reduced in insecticide treated plots as compared to control plots.

CHINTAMANI

The experiment was conducted with modified treatments. Three sprays were given and the incidence of minor pests were recorded before spray and 30 days after each spray and presented in Table 74. Least incidence of leaf miner, leaf and blossom webber and leaf thrips was noticed in T-5 (0.40, 0.12 and 0.89 respectively) followed by T-4, T-6 and T-1, 30 days after first spray. Least incidence of leaf and blossom webber, was noticed in T-5 (0.71 per cent) followed by T-4 (0.81), T-2 (0.91) and T-7 (0.92) and the least incidence of inflorescence thrips was noticed in T-5, T-4 (1.20 No./panicle) followed by T-2, T-6 and T-7, 30 days after second spray. The least incidence of inflorescence thrips, 30 days after third spray was noticed in T-7 (1.67 No./panicle) followed by T-6 (1.78), T-3 (1.79) and T-5 (1.91)

JHARORAM

The experiment was conducted in RBD with eight treatments and three replications. The investigation is aimed at evaluating the comparative effectiveness of different treatments with untreated control. Three sprays were given coinciding with foliage, flowering and fruiting stage of the trees. Pre-treatment and post-treatment observation was recorded as per proforma.

The incidence of leaf miner, leaf and blossom webber was less in T-5, T-4, T-6 and T-1 treatments after first spray. After second spray treatment T-5, T-4 and T-6 showed least incidence of leaf and blossom webber and

Table 74. Percent incidence of minor pests in different treatments before and 30 days after each spray (Chintamani)

Treat-ments	Pre-treatment counts			1st spray		2nd spray		3rd spray	
	Leaf miner	Leaf bloss-om webber	Leaf & thri- ps	Leaf miner	Leaf & bloss-om webber	Leaf thrips	Bloss-om webber	Inflore- scence thrips	Infloresc- ence thri- ps
T-1	1.39	0.76	2.42	0.42	0.13	0.90	2.95	4.99	8.86
T-2	1.48	0.73	2.36	3.54	0.97	2.75	0.91	1.73	6.01
T-3	1.37	0.70	2.14	3.45	1.00	2.79	3.87	5.50	1.79
T-4	1.46	0.83	2.47	0.46	0.13	0.91	0.81	1.20	5.83
T-5	1.35	0.75	2.25	0.40	0.12	0.89	0.71	1.20	1.91
T-6	1.45	0.71	2.19	0.41	0.13	0.89	2.79	5.06	1.78
T-7	1.48	0.85	2.35	3.26	0.99	2.70	0.92	1.75	1.67
T-8	1.49	0.76	2.40	3.48	0.91	2.69	3.77	5.86	9.15
SEM _t	0.15	0.10	0.29	0.31	0.05	0.24	0.12	0.31	0.25
CD at 5%	NS	NS	NS	0.94	0.15	0.73	0.36	1.09	0.76

leaf miner (Table 75). The results after third spray indicated no significant difference within the treatments.

Table 75. Incidence of minor pests in different treatments (Jhargram)

Treat- ments	Pre-treatment count (mean score)		After first spray		After second spray			Yield (kg/ tree)
	Leaf minor	Leaf & bloss- om we- bber	Leaf minor	Leaf & bloss- om we- bber	Leaf min- or	Leaf & bloss- som webber	Apple & nut borer	
T-1	1.40	1.56	2.86	2.07	8.71	7.98	7.00	1.87
T-2	1.81	1.43	11.63	4.78	7.87	6.03	4.50	1.94
T-3	1.67	1.64	14.41	12.97	12.5	12.56	2.26	2.05
T-4	1.09	1.81	2.63	1.58	2.23	2.05	1.90	2.25
T-5	1.41	1.53	2.09	1.78	1.98	1.97	1.53	2.35
T-6	1.60	1.73	2.75	2.43	2.43	4.67	1.56	2.00
T-7	1.97	1.85	9.48	9.32	9.32	6.57	1.95	2.11
T-8	1.99	1.75	15.00	12.80	22.57	21.93	10.10	1.49

MADAKKATHARA

The important minor pests that had a regular occurrence in the experimental plots were leaf roller, leaf miner, blossom webber and flower thrips. In the unsprayed plots the extent of shoots affected by leaf miner was upto a maximum of 22.50 per cent (after first spray) and the intensity of leaves affected was 30.25 (Table 76). In the plots that received the spraying the leaf miner attack was very low. No fresh attack could be noticed at one month after first spray. A maximum of 11 per cent panicle has been found affected by the caterpillars by webbing together the flowers. The second spray has reduced the extent of attack by blossom webbers and thrips. Single spray with monocrotophos at flushing or endosulfan at flowering was not effective in controlling thrips infestation.

Table 76. Infestation by minor pests in experimental plots (mean of three replications) mean percentage infestation (Madakkathara)

Treatments	Pre-count		After 1st spray		After second spray		After third spray			
	Leaf miner Shoot affected	Leaf Leaves rolled	Leaf miner Shoot affected	Leaf Leaves rolled	Panicle affected by blight	Thrips (mean No.)	Thrips (mean No.)	Mean score		
T-1	9.00	26.27	5.71	3.00	5.75	2.50	10.25	15.85	12.25	0.75
T-2	15.00	30.00	4.33	18.25	28.12	10.33	2.75	6.00	10.00	0.70
T-3	6.65	18.33	5.62	17.10	20.25	8.16	9.30	3.50	7.70	0.46
T-4	1.67	10.33	4.85	1.15	19.50	-	3.30	5.15	8.33	0.58
T-5	2.22	8.33	4.85	2.00	10.00	4.00	2.60	4.00	4.45	0.25
T-6	7.33	11.67	2.83	2.50	6.67	1.85	3.00	8.00	7.63	0.50
T-7	4.15	18.33	2.33	22.50	30.25	7.74	1.55	3.75	3.17	0.28
T-8	8.33	15.56	4.90	20.81	25.75	9.74	11.00	13.00	15.85	0.80

Natural enemies/pollinators

The predators like mirid bug, chrysopa and ants were present in the experimental plots. Ants, spiders, bees, flies and wasps were reduced in insecticide treated plots. However, the population of chrysopa and mirid bug was not seriously affected in the sprayed plot.

VRIDHACHALAM

During 1992-93, the trial was conducted on the control of minor pests of cashew with different insecticidal treatments. Three rounds of sprays of modified treatment were given at 30, 60 and 90 days interval. The percent incidence of shoot tip caterpillar and yield of nuts are recorded 30 days after each spray and presented in Table 77.

Table 77. Effect of spray schedule and incidence of shoot tip caterpillar (Vridhachalam)

Treat- ments	Percent damage per quadrant pooled					Yield in kg/tree & increase over con- trol
	Pre- treat- ment count	30days after 1st sp- ray	30days after 2nd sp- ray	30days after 3rd sp- ray	Mean	
T-1	4.52 (12.07)	1.08 (7.04)	0.0 (4.05)	0.0 (4.05)	0.36 (5.05)	0.710 (8.35)
T-2	3.09 (10.31)	13.92 (22.29)	3.99 (12.09)	0.0 (4.05)	5.97 (12.81)	3.53 (78.73)
T-3	0.25 (4.90)	11.94 (20.64)	2.99 (10.78)	0.0 (4.05)	4.98 (11.82)	2.33 (17.97)
T-4	11.38 (19.96)	2.67 (10.28)	0.99 (7.04)	0.0 (4.05)	1.22 (7.12)	3.500 (77.22)
T-5	2.50 (9.62)	2.43 (9.79)	2.10 (9.28)	0.0 (4.05)	1.51 (7.71)	3.500 77.22
T-6	3.95 (11.86)	2.04 (9.11)	0.58 (5.74)	0.0 (4.05)	0.87 (6.30)	4.620 (3.92)
T-7	1.45 (7.88)	10.20 (19.02)	4.11 (12.45)	4.0	4.77 (11.84)	4.78 (142.28)
T-8	6.2 (15.19)	12.16 (20.82)	6.95 (15.84)		6.37 (13.57)	1.975

(Figures in parenthesis are transformed values)

Based on the result obtained, all the treatments were significantly found well in controlling shoot tip caterpillar. Least per cent damage of shoot tip caterpillar was recorded in T-1 (0.36%) followed by T-6 (0.87%). The maximum shoot tip caterpillar damage of 6.37 per cent was recorded by untreated control. The percent incidence of shoot tip caterpillar was completely nil in all the treatments after third spray.

The maximum yield of 4.785 kg per tree was recorded in T-7 treatment with an increase of 142.28 per cent over control while the minimum of 1.975 kg/tree was found with untreated control. The trial will be continued for further observation and confirmation.

VENCURLA

The observations on flower thrips was recorded at peanut stage, pebble stage and matured nuts in 0-4 scale. For recording the observations forty nuts of each stage from each treatment were observed. The observations recorded on flower thrips at pea nut stage, pebble stage and matured nuts were analysed and presented in Table 78.

The results were statistically significant at all the stages. At pea nut stage, treatment T-7 was significantly superior to T-1 and T-8 while remaining all the treatments were at par with T-7 and each other. The order of efficacy was T-7, T-5, T-4, T-3 and T-6, T-2, T-1 and T-8. At pebble stage, treatment T-7 was significantly superior to rest of the treatments except T-5, while T-5 was at par with T-6 and significantly

superior to T-3, T-4, T-2, T-1 and T-8. The observations recorded on matured nuts indicated that the treatment T-6 was significantly superior to T-3, T-1 and T-2 and at par with T-7, T-5 and T-4. From above results, it can be concluded that the treatment, T-5 (scheduled spray) T-6 (only first and third spray) and T-7 (only second and third spray) were equally effective in controlling flower thrips on cashew.

Table 78. Incidence of flower thrips on cashewnut at different stages (Vengurla)

Treat- ment	Average nut surface damaged at		
	Peanut stage	Pebble Stage	Matured stage
T-1	20.20 (26.52) *	20.83 (27.08)	19.79 (26.37)
T-2	18.33 (23.28)	20.41 (26.76)	22.29 (27.91)
T-3	17.08 (24.27)	16.87 (24.19)	16.45 (23.90)
T-4	16.24 (23.74)	17.49 (24.66)	15.20 (22.94)
T-5	16.24 (23.72)	12.28 (20.43)	12.28 (20.48)
T-6	17.70 (24.73)	14.37 (22.12)	11.45 (19.75)
T-7	15.62 (23.24)	11.45 (19.68)	11.87 (20.10)
T-8	23.31 (28.86)	25.20 (30.11)	25.62 (30.34)

*Figures in parenthesis are arcsin values

Expt. 3: Control of foliage/inflorescence pests with neem products

(Bapatla, Vridhachalam and Vengurla)

The objective of the experiment is to find out the effect of natural neem products on the control of foliage and inflorescence pests. The experiment was suggested in the National Group Discussion of Cashew Research Workers, 1991.

Treatments

Six:

T-1	Neem oil (2%) spray
T-2	Neem seed kernel extract (5%) spray
T-3	Neem cake extract (5%) spray
T-4	Neem leaf extract (2%) spray
T-5	First, Second and third sprays with Monocrotophos, Endosulfan and Carbaryl
T-6	Control

Design: RBD

Replications: Three

No. of trees: 2/treatment

BAPATLA

Among all the neem products tried, maximum reduction in percentage of damage to shoot tips by H. haligramma and population of weevils and H. haligramma per lateral was recorded in neem cake extract 5% treated trees and equally faring well with both monocrotophos (0.05%) in first phase followed by endosulfan (0.05%) in second phase. Similarly minimum percent damaged nuts by L. monocusalis (1.20) and Nephopteryx sp. (1.52) was recorded in neem cake extract followed by insecticides treatment. Neem leaf extract 5% exhibited poor repellent action towards pest attack recording maximum per cent damage by H. haligramma and Mylocerus sp. Third spray with carbaryl could not be applied due to less and uneven damage in fruits and nuts dropping due to heavy winds.

All the neem products tried performed well in recording yields and out of which maximum (10.35 kg/tree) yield was in neem cake extract treated followed by neem seed kernel and equally on par with endosulfan. This has to be confirmed in 1992-93 seasonal experiment.

During 1992-93 season, the same experiment with all the neem products was initiated by February 1993 duly recording pre-treatmental counts of incidence of Myllocerus sp., Hipotima haligramma per lateral and Lamida moncusalis out of which incidence of Lamida moncusalis was very negligible. The experimental trees received only one spray by February 1993 as trees put forth flush very late and it is in progress, which will be continued upto May 1993 (Table 79).

VRIDHACHALAM

A new trial with different neem products for the control of foliage and floral pests will be laid out to find out the effective neem product in order to alternate the synthetic pesticides.

The existing prophylactic control trials with the different repellents and waste products will be completed and a new prophylactic trial with neem products will be laid out to find out the effective prophylactic measure against these pests.

During the year 1992-93 a trial on the effect of plant products against the pests of cashew was initiated. During the year only tea mosquito bug, shoot tip

Table 79. Abstract of pest incidence (Bapatla)

Treat- ments	Pre-treatmental counts		Post-treatmental counts				Yield kg/ tree
	% later- als dama- ged by H. h.	Population of H.h./ lateral	% later- als dama- ged by H.h.	Population of H.h. Weevils /lateral	Undamaged nuts LW	ANB	
T-1	9.43	0.08	8.49	0.08	1.51	2.62	9.52
T-2	7.17	0.07	8.94	0.09	2.52	4.22	10.15
T-3	12.69	0.07	7.33	0.07	1.20	1.52	10.35
T-4	7.34	0.07	11.43	0.11	5.22	6.50	9.90
T-5	6.77	0.06	5.33	0.08	2.02	5.20	8.58
T-6	6.44	0.05	14.35	0.14	5.46	9.26	6.33

caterpillar and inflorescence caterpillar were observed. Three sprays were given at flushing, flowering and fruiting periods and compared with the standard spray schedule. The results are presented in Table 80.

Table 80. Effect of plant products against tea mosquito and shoot tip caterpillar (Vridhachalem)

Treat- ment	Tea mosquito bug			Yield in kg/ tree	Percent increase over control
	Mean % of da- mage/ quadra- nt	Mean % score of da- mage	Mean % damage/ quadra- nt		
T-1	6.90 (12.89)**	0.71* (1.03)	2.06 (8.16)	3.650	25.43
T-2	6.04 (14.00)	0.54 (1.00)	1.32 (6.96)	4.340	49.14
T-3	8.58 (14.11)	1.02 (1.15)	2.57 (9.10)	3.180	12.33
T-4	12.20 (16.21)	0.78 (1.06)	4.62 (11.66)	4.200	44.33
T-5	5.23 (12.86)	0.60 (1.00)	0.35 (5.08)	4.660	60.14
Kungam oil 2%	8.15 (13.72)	0.95 (1.17)	3.98 (11.09)	3.540	21.65
T-6	17.94 (24.46)	1.79 (1.49)	8.62 (15.37)	2.930	-
CD	6.32	0.88	1.96	1.61	

** Figures in parenthesis are transformed value

* Figures in parenthesis $\sqrt{x+0.5}$

The above results have indicated that among different plant products tried the neem seed kernel extract 5% and neem oil 2% have recorded the minimum tea mosquito bug damage (6.04 and 6.90 per cent respectively). The former plant product also showed the minimum score of damage of 0.54. However, the highest mean yield of 4.660 kg of nut was found besides recording the

lesser score of damage (0.60) which is equally comparable with neem seed kernel extract in standard spray schedule. The untreated control ~~showed~~ both maximum per cent of damage (17.94 per cent) and per cent score of damage (1.79) respectively.

The minimum shoot tip caterpillar damage of 0.35, 1.32 per cent was observed in standard spray schedule and neem seed kernel extract 5% respectively while the maximum damage of 8.62 per cent ^{was} recorded in untreated control.

With regard to yield the highest nut yield of 4.660 kg/tree was recorded in trees sprayed with standard spray schedule. However, all the treatments recorded higher yield over the untreated control. The trial will continue for further confirmation.

VENGURLA

Three sprays of treatments were given at monthly interval, coinciding with emergence of new flushes, flowering and fruiting. While preparing the spray solution of neem products, Teepol @ 0.5 ml/lit. of solution were added. The observations on tea mosquito and flower thrips were recorded as per earlier experiment. The observations on predators and insect vectors were also recorded. The observations recorded on tea mosquito are presented in Table 81.

It could be seen from the data, that the incidence of tea mosquito was relatively lesser in treatment scheduled sprays. However, the results were statistically non-significant.

Table 81. Incidence of tea mosquito, *Helopeltis antonii* S. in different treatments (Vengurla)

Treat- ments	Average per cent shoots/panicles damaged 30 days aft r spray		
	1st spray	2nd spray	3rd spary
T-1	0.00(0.00)*	1.03(4.13)	5.61(13.64)
T-2	0.00(0.00)	0.63(3.22)	4.68(12.43)
T-3	0.00(0.00)	1.19(5.30)	5.64(13.50)
T-4	0.65(3.26)	1.36(5.66)	5.76(13.58)
T-5	0.78(3.61)	1.04(4.16)	3.55(10.66)
T-6	0.00(0.00)	0.88(3.80)	5.67(13.69)
SE +	1.15	2.56	1.03
CD at 5% NS	NS	NS	NS

*Figures in parenthesis are arcsin values

The observations recorded on flower thrips at peanut stage, pebble stage and matured nuts are presented in Table 82.

Table 82. Incidence of flower thrips on cashewnut at different stages (Vengurla)

Treat- ment	Average nut surface damaged at		
	Peanut stage	Pebble stage	Matured nuts
T-1	22.81(28.43)*	28.84(32.39)	33.90(35.55)
T-2	28.75(32.24)	29.68(32.90)	35.31(36.37)
T-3	22.81(28.45)	26.24(30.77)	28.43(32.11)
T-4	30.00(33.08)	25.78(30.48)	34.06(35.54)
T-5	27.18(31.27)	19.99(26.54)	19.68(26.30)
T-6	26.56(30.92)	30.46(32.42)	29.84(32.93)
SE +	1.21	1.32	
CD at 5%	NS	3.96	

* Figures in parenthesis are arcsin values

It is seen from the above Table that the results are non-significant at pea nut stage, while the treatment T-5 (scheduled spray) was observed to be significantly

The observations on predators viz. lady bird beetles, spiders, crysopa and preying mantids were also recorded (Table 83). The observations recorded on insect visitors in natural neem product trial, indicated that the population of lady bird beetles was maximum during fruiting stage i.e., 2.25 to 3.75 beetles/sq.m. The population of spiders was ranging between 0.25 to 2.00/sq.m. While crysopa egg masses were also observed, maximum upto 0.75 sq.m. In addition, two types of preying mantids were also observed.

Table 83. Population of predators (Vengurla)

Treat- ments	Average No./sq.m.		
	Lady bird beetles	Spiders	Crysopa egg masses
T-1	3.75	1.50	0.75
T-2	2.75	0.25	0.50
T-3	2.25	0.75	0.50
T-4	2.75	1.00	0.75
T-5	2.50	0.25	0.00
T-6	2.25	2.00	0.75

Cashew is observed to be poor insect visiting plant, only two types of dipterous flies and one type of skipper were observed to be rarely visiting during flowering period. Two types of ants, one black medium size and another very small dull brown coloured were observed during fruiting season.

Ent. 2: Control of stem and root borer
 Expt.1: Prophylactic control trial
 (Bapatla, Bhubaneswar, Jhargram, Madakkathara,
 Vridhechalam and Vengurla)

Old treatment

T-1	Coal tar : kerosene (1:2)
T-2	Coal tar : kerosene (1:4)
T-3	Kaoline paste
T-4	Aldrin swabbing 0.1%
T-5	BHC swabbing 0.2%
T-6	Control

Modified treatments

The treatments were modified in the National Group Discussion of Cashew Research Workers, 1991.

T-1	Kaoline swabbing
T-2	HCH (0.2%)
T-3	Neem oil (5%)
T-4	Neem cake extract (5%)
T-5	Neem seed kernel extract (5%)
T-6	Control

BAPATLA

Among all the six treatments tried during 1991-92, except neem seed kernel extract, neem oil 5% swabbing on the uninfested trunk during April month was recorded to be acting as good prophylactic measure keeping away the borer attack, upto 90 days where as minimum percent i.e., 3.33 per cent trees were susceptible to borer attack after 120 days. Followed by this, 4 per cent trees were found infested freshly in neem cake 5 per cent treated blocks after 120 days.

In the blocks treated during December 1992, data was recorded upto 90 days only so far (Table 84). All the neem products i.e., neem oil 5%, neem cake extract 5%, neem seed kernel extract 5% and Sevidol 4G fared well as prophylactic measure from borer attack upto 90 days recording no infestation eventhough surrounded by infested trees. The experiment is in progress.

Table 84. Abstract of borer incidence - Prophylactic trial (Bapatla)

Treat- ments	No. of trees treated		No. of trees infested/days after treatment				120		% infesta- tion after treatment Apr. Dec. 92 92		
	Apr. 92	Dec. 92	Apr. 92	Dec. 92	Apr. 92	Dec. 92	Apr. 92	Dec. 92			
T-1	20	18	--	--	2	2	3	2	3	15.0	11.11
T-2	20	--	--	--	2	--	3	--	3	15.0	--
** >	--	12	--	--	--	--	--	--	--	--	--
T-3	30	22	--	--	--	--	--	--	1	3.33	--
T-4	25	22	--	--	--	--	--	--	1	4.00	--
T-5	--	24	--	--	--	--	--	--	--	--	--
T-6	12	10	--	--	2	--	--	2	3	25.00	20.00

**Sevidol (Nov. 92) granules-150g

Table Contd.....

Treat- ments	Stages of infestation in no. of infested trees											
	Early		Middle		Advanced		Dead					
	Apr.	Dec.	Apr.	Dec.	Apr.	Dec.	Apr.	Dec.	Apr.	Dec.	Apr.	Dec.
T-1	2	1	1	1	-	-	-	-	-	-	-	-
T-2	2	-	1	-	-	-	-	-	-	-	-	-
Sevidol (Nov. 92)	-	granules-	-	-	-	-	-	-	-	-	-	-
150g	-	-	-	-	-	-	-	-	-	-	-	-
T-3	1	-	-	-	-	-	-	-	-	-	-	-
T-4	1	-	-	-	-	-	-	-	-	-	-	-
T-5	-	-	-	-	-	-	-	-	-	-	-	-
T-6	1	-	1	-	1	-	-	-	-	-	-	-

BHUBANESWAR

The trial was laid out with the modified treatments in the Aiginia plantation of Department of Soil Conservation, Orissa. The treatments were applied during November 1992 and the observations were taken at monthly intervals on percentage of plants with fresh infestation of stem and root borers Plocaederus ferruginous L. (Table 85). Before carrying out the treatments, the collar region and exposed roots were cleaned. Table shows that in Kaoline swabbing, Neemcake extract (5%) and neem seed kernel extract (5%) treatment there was less infestation of stem and root borer than the other treatments.

Table 85. Effect of prophylactic treatments on cashew stem and root borer at Bhubaneswar

Treatments	Percentage of plants infested after treatment				Stages of infestation in infested trees(% plants)			
	Dec. 92	Jan. 93	Feb. 93	Mar. 93	Early	Mid-	Avan-	Dead
					le	le	ced	
T-1	6.38	6.38	8.51	8.51	4.25		2.12	2.12
T-2	12.50	14.41	14.41	14.41	2.04	2.04	4.08	-
T-3	11.53	11.53	11.53	11.53	9.61	-	-	3.84
T-4	6.26	8.44	8.44	8.44	6.12	2.94	-	-
T-5	5.55	5.55	9.25	9.25	3.70	3.70	-	1.85
T-6	14.03	14.03	17.54	17.54	3.50	3.50	3.50	7.01

JHARGRAM

The results presented in Table 86 reveal that there was absolutely no infestation observed on the tree treated with HCH (0.2%). The infestation was negligible with neem oil (5%) and neem seed kernel extract (5%).

Table 86. Effect of prophylactic treatments on stem, and root borer (Jhargram)

Treat-ments	Total No. of trees treated	No. of trees having stem borer eggs*		No. of trees infested		Percentage of infestation after treatment	Stage of infestation in infested trees			Dead			
		Nov.	Apr.	Nov.	Apr.		Early stage	Middle stage	Advanced stage				
						Nov.	Apr.	No.	%	No.	%	No.	%
T-1	20	2	5	1	3	5	15	3	15	2	10	-	-
T-2	20	2	2	-	-	-	-	-	-	-	-	-	-
T-3	20	1	3	-	1	-	5	-	-	-	-	-	-
T-4	20	1	3	1	2	5	10	2	10	-	-	-	-
T-5	20	2	4	-	1	-	5	1	5	-	-	-	-
T-6	20	2	5	2	4	10	20	4	20	3	15	-	-

MADAKKATHARA

This experiments was started during November, 1991. The effectiveness of neem products, sevin and kaolin, clay applied on the tree trunk and exposed roots for preventing the infestation by stem and root borer in cashew was assessed.

Eighteen year old trees of the old CYT (seedlings) area was selected and six blocks were demarcated. The area under each block consisted of about 50-60 trees. 25 healthy and uninfested trees were selected for the treatment, in each block and experimental trees were selected in such a way that there are a minimum of five trees and maximum of 10 trees already affected by stem and root borer which may serve as the source of infestation. Each treatment block was separated from the other by at least two rows of trees around.

Before the application of treatments the tree trunk upto one metre height and the exposed roots were cleaned by using a coir brush to dislodge the termite galleries, stem borer eggs, and grubs if any. The neem products were extracted and prepared. The neem extracts were applied on the stem portion upto a height of one meter above ground level and on exposed roots by using a coir brush. First round of application was given during November 1991 and the second treatment during May, 1992. Observations were recorded at monthly intervals and noted the oviposition, presence of grubs etc. on treated and untreated trees in each block (Table 87)

During April 1992 one tree each was infested in neem oil and kaolin treatments. Stem borer eggs were also found on one of the trees in the above treatments

Stem and root borer infestation as influenced by prophylactic treatments (1992-93) (Madakkathara)

Treatments	Percentage of infestation											
	Apr. 92	May 92	Jun. 92	Jul. 92	Aug. 92	Sep. 92	Oct. 92	Nov. 92	Dec. 92	Jan. 93	Feb. 93	Mar. 93
T-1	4.00	8.00	-	-	-	4.00	8.00	8.00	8.00	-	-	4.00
T-2	-	-	-	-	4.00	4.00	4.00	4.00	4.00	-	-	4.00
T-3	4.00	16.0	-	4.00	4.00	8.00	16.00	16.0	16.0	-	-	8.00
T-4	-	-	-	-	-	-	4.00	4.00	4.00	-	-	4.00
T-5	-	-	-	-	-	4.00	4.00	4.00	4.00	-	-	8.00
T-6	12.00	20.0	20.0	20.0	20.0	16.0	24.00	24.0	20.0	20.0	20.0	12.0

No attack could be noticed in T-2, T-4 and T-5 whereas these trees were attacked by stem and root borer in untreated control. Six months after the first application of treatments i.e., during May 1992, two trees were attacked in neem oil treatment, and four trees in kaolin treatment as against five trees in untreated control.

The second round of application of treatments was given in May 1992. Before the application of treatments all the trees were carefully observed and cleared off the infestation. The treatments were applied during the last week of May 1992. Fresh attack could not be noticed in the case of neem oil 5% (T-1), neem cake extract (5%) (T-4) and BHC (0.2%) (T-5) treatments till August, 1992. Four months after the treatment, infestation was noticed in all the treatments except in T-4 (neem cake extract 5%). Maximum infestation was noticed in untreated control throughout the period of observation.

The third round of treatments was applied during November 1992. All the treatments were effective in preventing stem borer attack for the first two months. Sevidol 4G was found to be effective in preventing the stem borer attack for three months. Invariably more number of untreated trees were seen infested in all the blocks.

VRIDHACHALAM

An experiment was started in July 1992 with modified treatments. The treatments were applied during the first week of July 1992 and fourth week of November

1992. 25 trees were selected. The observations were recorded on the incidence of stem and root borer at monthly intervals. The results are presented in Table 88.

Table 88. Effect of prophylactic treatments on stem and root borer (after treatment) (Vridhachalam)

Treat- ments	Total eggs	No. of trees with egg	No. of trees affected			No. of trees dead
			Early infesta- tion	Middle infestation	Advan- ced	
T-1	-	-	-	-	-	-
T-2	5	1	12.00	-	-	-
T-3			15.00			
T-4			4.00			
T-5			4.00			
T-6			4.00			
T-7	8	3	36.00			

T-1 = BHC 0.2%, sevidol 50g/tree
 T-2 = Kaoline paste + synthetic adhesive
 T-3 = Coal tar+kerosene (1:2)
 T-4 = Neem oil 5%
 T-5 = Neem seed kernel extract 5%
 T-6 = Neem cake extract
 T-7 = Control

The results revealed that all the treatments were found to be effective against the stem and root borer incidence. Sevidol 50g/tree was found to be recorded nil incidence.

VENCURLA

The treatments were applied in a block of 25 trees with at least 2-4 trees already infested in each block. The treatments except Sevidol were applied on collar portion upto 1m height and on exposed roots. The treatment sevidol was applied @

@ 50g/tree in circular trench 1.5m away from the trunk and 50 lit. water/tree was applied.

The cumulative incidence on stem and root borer after application of the treatments is given in Table 89.

Table 89. Cumulative incidence of stem and root borer

Treatments	No. of fresh tree infested out of 25 trees	
	No. trees	% incidence
T-1	0-0	0.00
T-2	2	4.00
T-3	3	12.00
T-4	1	4.00
T-5	0	0.00
T-6	1	4.00

It is seen from the above table that the incidence of stem and root borer was very erratic. The maximum incidence of 12 per cent with 3 freshly damaged trees were observed in treatment T-3, while no fresh incidence was observed in Kaoline swabbing and neem seed kernel extract. Only one tree was observed to be freshly infested by stem and root borer in treatment control.

Ent. 3: Bioecology of pests of regional importance and survey of pest complex and natural enemies
(Bapatla, Chintamani, Jhargram, Madakkathara, Vridhachalam and Vengurla)

The aim of this Project is to find out the impact of ecological factors, i.e., temperature, relative humidity and rain fall on pest infestation build up and outbreak of major pests of the region. Another aspect is the survey of pests and natural enemies.

BAPATLA

The pests studied for correlation with ecological factors were:

1. Shoot and blossom webber - Lemida moncusalis Wlk.
(both on foliage and nuts)
2. Weevils - Myloccerus sp.
3. Leaf miner - Acrocercops syngramma
4. Shoot tip and inflorescence caterpillar -
Hipotima haligramma
5. Apple and nut borer - Nephopteryx sp. .

Based on this, results were concluded that:

(i) Increase in temperature was favourable for multiplication of all the fruit pests i.e., L. moncusalis, Hipotima haligramma and Nephopteryx sp.

(ii) Percentage of leaf miner (A. syngramma) increased with decline in all the three weather parameters while infestation of L. moncusalis on leaves was negatively correlated with relative humidity.

(iii) Maximum outbreak of Plocaederus ferrugineus L. was recorded during May to July and continued upto October November months in rainy season while decreased in summer months (Table 90).

Table 90. Status and seasonal abundance of pests recorded on Cashew (1992-93)
(Bapatla)

Sl. No.	Common name	Name of the pest Scientific name	Month of occurrence	Intensity
1.	Stem and root borer	<u>Plocæderus ferrugineus</u> L.	Aug. Dec.	Severe
2.	Shoot and blossom webber	<u>Lamida monocusalis</u>	Oct.-Nov./Dec-Jan/ Feb-Aug	Low/ Moderate/ High
3.	Leaf miner	<u>Conopomorpha syngra- mna</u>	Aug. Sep-Nov	Less Moderate
4.	Hairy caterpillars (3 species)	<u>Metanastria hyrtaca</u> <u>Euproctis scientillians</u> <u>Estigmene lactenea</u>	Mar-May	
5.	Shoot tip caterpillar	<u>Hipotina haligramma</u>	Oct-Nov/Dec-Feb. Jan-Feb	Low/High Moderate
6.	Apple and nut borer	<u>Nephopteryx</u> sp.	Jan-Feb	Moderate
7.	Weevils	<u>Myloccorus</u> sp.	Mar/Aug-Sep Oct-Jan	Low/Moderate. High (on panicles)
8.	Leaf folders	<u>Kaleptilea tiselea</u> <u>Duode aprorbis</u>	Oct- Nov	Moderate
9.	Tea mosquito	<u>Helopeltis antoniji</u>	Nov-Feb	Moderate (in high altitude areas)

Extensive surveys were made from Srikakulam to Nellore district and the pests status was recorded in different districts which is presented in Table 91.

Table 91. Pest status in different districts in A.P. (Bapatla)

Sl. No.	Districts surveyed & Month	Pests present	% infestation	Intensity
1.	Nellore-Kavali, surrounding private plantations March, 1992	<u>Nephoteryx</u> sp. <u>H. haligramma</u>	6-10 5 shoot tips	Mid to severe Moderate
2.	West Godavari-Eluru, Chebrolu Lekshmipuram April 1992	Flower thrips- <u>Scirtothrips</u> <u>rosei</u> Hairy caterpillar- less <u>Metanastria hyrcanica</u> <u>Estigmene lactenes</u> <u>Euphyas scintillans</u>	1-2 75	Less Severe
		Tea mosquito Apple nut borer- <u>Nephoteryx</u> sp.	1-2 2-5	Less Moderate
3.	Guntur district- Perali, Karlapalem, Nandirajuthota, Mettayapalem- Jun. Aug. 1992	Stem and root borer <u>Plocaederus</u> <u>ferrugineus</u> Leaf miner <u>A. syngamma</u> Leaf webber (<u>L. monoculalis</u>)	10 (Old plantations) 1-2 1-2	Severe Less Less
4.	Prakasam-Ramannapeta, Vetapalem- October 1992	Stem and root borer (<u>P. ferrugineus</u> L.)	5-10 (Old plantations)	Severe

Table ctd.....

Table (Ctd.....)

5. Visakhapatnam- Private planta- tions November 1992	Shoot tip cater- pillar		
	<u>H. haligramma</u>	1-2	Less
	Leaf miner	1-2	Less
	Termites (Red soils)	2-4	Less
6. West Godavari- Rajahmundry, Raghavendrapou- ram, Radhaya- palem- December, 1992	Shoot tip ca- terpillar	1-2	Less
	Weevils		
	<u>Mylocerus</u> sp.	2-4	Medium

In general, throughout the State, the plantations came to flowering very late and pest incidence was also very less as the season was escaped. From the surveys, conclusions arrived at are:

(i) Borer infestation was more in sandy soils and old plantations of above 20-25 years old.

(ii) Plantations existing in high altitude areas of Srikakulam, Visakhapatnam and West Godavari districts are prone to Tea mosquito infestation compared to plantations in plain areas. Parasites and predators activity was very less on cashew pests during 1992-93 crop season.

Host	Parasites emerged	Classification	Month	% para- of oc- sitisa- curren- tion ce
<u>Lamida mon- cusalis</u> Wlk.	<u>Apanteles</u> sp.	Fy: Braconi-	Jul.	50.0
	<u>Apanteles</u> sp.	dæ	Aug.	21.7
	<u>Elasmus</u>	Fy: Elasmiid-	Sep.	16.0
	<u>Johnstonii</u>	æ	Oct.	19.8
			Dec.	1.5
			Jan-Apr	Nil

Semilooper	Wasp	or:Hymenop-	Sep.	16.6
<u>Thallosodes</u>		tera	Oct.	37.5
<u>quadraris</u>		Fy: Ichneu-	Dec to	
		monidae	Mar	Pest is
			negligible	
Defoliator	Housefly	or: <u>Diptera</u>	Sep.	14.3
<u>Bombetelia</u>	(Predator)		Oct.	5.20
<u>jacosatrix</u>	(Pupal)			

In general, as the pest load of leaf webber, defoliators and semiloopers was less, after December months, parasitisation was also decreased, may be due to unfavourable climatic conditions for parasite co-existence.

BHUBANESWAR

Bioecology of some important pests of cashew was studied during the period August 1992 to March 1993. The occurrence of pests in different months has been recorded.

Shoot tip caterpillar (Hypotima haligramma Mey.)

This is the major pest of the region and it is active in the field from August to March. The peak incidence of this pest (a maximum of 26.52 per cent shoot infestation) was recorded during the second fortnight of October. Thereafter, the infestation decreased possibly due to prevailing low temperature. Again during the month of March, its population build up was noticed, infesting both shoots and developing nuts.

Leaf miner (Acrocercops syngramma M.):

Leaf miner infestation was observed for a brief period from October to first fortnight of December. The

peak period of incidence (a maximum infestation of 7.49 per cent shoots with 12.36 per cent leaves) was noticed during second fortnight of October. During its peak incidence on an average three larva per leaf was observed.

Leaf thrip (Rhipiphorothrips cruentatus Hood):

The foliage thrip infestation was observed in old leaves during October to February. The peak period of incidence (maximum of 5.6 nos/leaves) was recorded during December first fortnight. After February its occurrence was not noticed.

Inflorescence thrips: Two species of thrips were found attacking the inflorescence, they are:

(a) Yellow thrips (Frankliniella schultzi Trybom):

Its population build up started in December and reached maximum (7.78 Nos/inflorescence) during second fortnight of January. Thereafter its activity decreased gradually.

(b) Black thrips (Haplothrips ceylonicus Schumtz)

Its activity was observed from December to March. Peak period of its activity was noticed during early part of February (3.75 nos./inflorescence). After ceasation of flowering its activity declined.

Apple and nut borer (Unidentified):

A mild incidence of apple and nut borer was observed during March. The species is to be identified,

Brown aphid (Toxoptera ordinae Vd.G.):

The incidence of brown aphid was observed during winter months (December to early-February). The peak period of its activity was during first fortnight of January, during which on an average 4.4 per cent inflorescence was infested with brown aphid.

Besides the above mentioned pests, other minor pests like mealy bugs (Ferrisia virgata Kll.) leaf weevils (Apion tumidium G., Mylocerus discolor B. and Peltotracheins pubes F.), Bark borer (Indarbela tetraonis Mo.) and flower beetle (unidentified) were also noticed. But the damage was negligible.

Natural enemies:

Natural parasitization was noticed on shoot tip caterpillar by an unidentified parasite. Maximum parasitization of 3.33 per cent was noticed during October 1992 (Table 92). The other predators present in cashew ecosystem were the spiders (Argcope sp.), mirid bug (unidentified), praying mantis, robber fly and black ants, lady bird beetle (Verania discolor F., Menochilos sexmaculata F. and Verania cincta Gorb.), The activity of lady bird beetle (all the three species) was maximum during January and February.

Table 92. Natural parasitization of shoot tip caterpillar Hypotima haligramma Mey. at Bhubaneswar

Month/Year	No. of caterpillars examined	No. of parasitized caterpillars	Per cent parasitism
1992			
Aug.	45	--	0.00
Sep.	63	1	1.58
Oct.	90	3	3.33
Nov.	72	2	2.77
Dec.	38	--	-
		Average	2.35

Table 93. Seasonal occurrence of major pests of the region (Chintamani)

Month/fort- night	Tea mcs- quito (%)	Leaf mi- ner (%)	Leaf & blossom webber (%)	Leaf th- rips (No./ leaf)	Infloresc- ence thrips (No./panic- le)	Fruit and nut borer (%)
Jan. 93 I	8.32	4.03	5.83	13.12	---	---
II	8.62	4.31	6.98	14.64	---	---
Feb. 93 I	7.38	3.32	7.31	16.68	0.36	---
II	6.31	1.62	8.36	10.01	0.83	---
Mar. 93 I	6.48	-	6.98	8.31	2.61	---
II	6.36	-	5.12	3.32	4.86	---
Apr. 92 I	36.32	1.01	19.36	4.02	11.33	0.95
II	32.46	---	15.22	0.81	10.01	2.68
May. 92 I	23.18	---	0.62	---	20.05	12.32
II	20.62	---	6.31	---	16.08	16.61
Jun. 92 I	10.31	---	3.22	---	10.11	8.52
II	2.12	---	1.42	---	3.93	3.58
Jul. 92 I	1.08	1.32	---	---	---	0.31
II	1.13	4.64	---	---	---	---
Aug. 92 I	2.08	5.98	0.28	0.1	---	---
II	3.19	7.68	0.96	2.02	---	---
Sep. 92 I	4.63	8.25	1.31	4.62	---	---
II	6.03	9.81	1.68	5.76	---	---
Oct. 92 I	5.06	10.32	2.93	6.78	---	---
II	4.31	8.26	3.21	4.36	---	---

Table (ctd.....)

Nov. 92 I	3.88	7.31	3.91	4.31	--
II	5.63	6.38	4.21	6.81	--
Dec. 92 I	6.83	5.81	5.24	7.83	--
II	7.36	4.32	5.44	10.12	--

Leaf miner:

The population build up of leaf miner started during first fortnight of July and reached maximum in the first fortnight of October (10.32%) and thereafter gradual reduction was observed and it was absent after second fortnight of February. Unlike previous years, this year, the per cent incidence was very low due to cold wave during November and December. During off-season they survived on young plantation.

Leaf and blossom webber:

The population of leaf and blossom webber was noticed during first fortnight of August 1992 and it reached maximum in second fortnight of February 1993 (8.36%) and thereafter gradual reduction was observed and vanished after second fortnight of June, 1992.

Leaf thrips:

The population build up started during first fortnight of August and reached maximum (16.68 No./leaf) during first fortnight of February and thereafter gradual reduction was observed. The population of thrips vanished completely after second fortnight of April. During off-season they feed and breed on young plants of cashew.

Inflorescence thrips:

The population build up of inflorescence thrips started during first fortnight of February due to delayed flowering and reached maximum during first fortnight of May (20.06) and vanished completely after second fortnight of June.

Fruit and nut borer:

Maximum incidence (16.61%) of fruit and nut borer was noticed during second fortnight of May and thereafter gradual reduction was noticed and vanished completely after first fortnight of July. The incidence of the pest was very severe on off-season fruiting plants.

Survey of pest complex and natural enemies:

The pests and natural enemies recorded during the survey in Kolar district of Karnataka are presented in Table 94.

The incidence of most of the major pests was low and few minor pests were recorded during the year. Two bronid parasites viz. Brocon bravicornis and Apanteles sp. on leaf and blossom webber and predator Menochelus sexmaculata on Toxontara odinae were recorded. The per cent parasitization was 3 to 5 per cent and 4 to 9 per cent respectively.

Table 94. Pests recorded on cashew in maiden parts of Karnataka and their intensity

Sl. No.	Common name	Scientific name	Month of occurrence	Intensity
<u>Major pests</u>				
1.	Tea mosquito	<u>Helopeltis antonii</u> S.	Through-out yr.	Low to moderate
2.	Leaf miner	<u>Conopomorpha syngamma</u> M.	Jul to Jan.	-do-
3.	Leaf and blossom webber	<u>Lamida monocusalis</u> Walk.	Jul. to Apr.	-do-
4.	Leaf thrips	<u>Selenothrips rubrocinctus</u> Giard. <u>Rhiniphorothrips cruentatus</u> H. <u>Retithrips syriacus</u> M.	Jul. to Mar.	-do-

Table ctd.....

Table (ctd.....)

5. Inflorescence thrips	<u>Scirtothrips dorsalis</u> G. <u>Rhynchothrips raoensis</u> G.	Feb. to Apr.	Low to mo- derate
6. Termites	<u>Odontotermis obesis</u> Ramb.	Through out yr.	Moderate to low
7. Aphid	<u>Toxoptera odinae</u> Van.	Jan. to Apr.	Low to m - derate
8. Leaf weevils	<u>Myloccerus discolor</u> B.	Through out yr.	-do-
9. Fruit and nut borer	<u>Thylocoptele panero-</u> <u>sana</u> M.	Mar. to Jul.	-do-

Minor pests

1. Leaf roller	<u>Hypotima haligramma</u> M.	Sep. to Jan.	Low
2. Bark eating caterpillar	<u>Indrabebe tetraonis</u> C.	Through out yr.	-do-
3. Looper	<u>Oenaspile flavifusca-</u> <u>ta</u> W.	Sep. to Jul.	-do-
4. Scales	<u>Ceroplastes floreden-</u> <u>sis</u> C.	Jan. to May.	-do-
5. Apple and nut borer	<u>Nephoteryx</u> sp.	Mar. to Jul.	-do-

<u>Parasites and predators</u>	<u>Host</u>	<u>% Parasitati-</u> <u>on</u>
1. <u>Bracon brevicornis</u>	On larvae of <u>Lamida</u> <u>noncusalis</u> Wk.	3 to 5
2. <u>Apanteles</u> sp.	-do-	4 to 9
3. <u>Menochilus sexmaculata</u>	On adult and nymph <u>Toxoptera odinea</u>	

JHARGRAM

The divergent ecological situations available in West Bengal have profound effect on the infestation build up and out break of pests in cashew plantations. Incidence of different important pests on cashew in this region was recorded throughout the year (Table 95).

Tea mosquito:

Tea mosquito appeared during the month of October. Population of this pest increased gradually and reached maximum during the month of January and existed on the plant upto April. This pest caused moderate to severe damage in different parts of the State. The mean incidence of this pest was 2.32 during the month of October. The percentage of shoot and panicle damage was highest during the month of January (26.33). It was observed that practically no infestation could be recorded during the month of May to September.

Shoot and blossom webber:

The occurrence of this pest was recorded during the first fortnight of August and increased very rapidly to reach the peak in second fortnight of October, followed by a rapid decline but existed on the plantations upto first fortnight of April. The per cent infestation were 28.5, 36.87 and 20.0 during the months of September, October and November respectively. Very rarely and in very low numbers the larvae of shoot and blossom webber were noticed during the month of February, March and April.

Table 95. Correlation of weather parameters and occurrence of cashew pest during the year 1991-92 at Jhargram

Months	Total rain-fall (mm)	No. of rainy days	Temperature (°C)		Relative humidity (%)		Percentage of damage					
			Max.	Min.	AM	PM	Tea mosquito	Shoot & blossom webber	Leaf minor	Apple & nut ps borer	Thri-155	
Oct. 91	130.8	8	34.8	24.0	70.4	70.6	2.32	36.87	25.0	-	-	-
Nov.	23.8	2	29.8	18.8	61.6	58.7	7.33	20.0	22.5	-	-	-
Dec.	46.0	4	24.5	12.2	85.2	59.7	14.8	12.33	18.3	-	-	-
Jan. 92	4.0	1	23.5	11.7	80.6	48.7	26.3	2.04	10.6	-	-	5.33
Feb.	14.6	2	26.3	14.7	77.2	55.4	24.3	1.68	6.3	4.42	7.73	-
Mar.	-	-	34.1	20.2	82.0	48.0	10.6	1.32	-	18.33	18.0	-
Apr.	58.2	5	34.3	23.5	78.8	51.0	1.66	1.02	-	-	-	-
May.	97.8	13	36.6	24.3	80.6	53.1	-	-	-	9.11	-	-
Jun.	375.2	11	34.0	25.2	83.4	63.4	-	-	-	-	-	-
Jul.	421.4	20	32.2	25.0	88.5	80.8	-	1.61	-	-	-	-
Aug.	226.8	16	31.4	25.3	87.9	83.0	-	9.38	2.08	-	-	-
Sep.	170.8	10	31.7	25.8	84.9	80.6	-	28.5	13.8	-	-	-

Leaf minor:

Incidence of this pest could be noticed during the post monsoon flushes. Occurrence of recordable population of leaf minor was available from the second fortnight of August (2.07) and population steadily increased during the month of October (25.0) and decreased thereafter. Practically no infestation could be noticed from the month of March to July.

Apple and nut borer:

Incidence of apple and nut borer was recorded during the first fortnight of February (4.02) coincided with reproductive phase of the plants and reached the maximum during the month of March (18.33) followed by a rapid decline.

Thrips:

Population of thrips were noticed during the month of January (5.33) and increased upto March (18.0) followed by rapid decline. Incidence of this pest could not be recorded during the month of May to December.

Survey of pest complex and natural enemies:

Survey were conducted in the districts of Midnapur East, Midnapur West, Bankura and in different plantations of West Bengal Forest Department namely, Salbani, Pukhuria, Jambani, Bikash Bharati, Gadro, Chandri, Khemasuli, Belpahari, Sevayatan (Midnapore West), Depal, Contai, Tickra, Deolihat, Pddubar, Mangalpur, Hirapur, Hanipur, Gobindopur, Simlapal, and Plantations of State Cashew Farm, Digha (Midnapore East).

About 32 species of insects have been recorded (Table 96) to occur during the different seasons in the area during the year 1991-92.

Six species of spiders and three species of co-cinellid beetle were recorded and collected for identification. It was noticed that about 11.2 per cent and 6.3 per cent of the populations of shoot and blossom webber and leaf minor were parasitized by the braconid parasite.

MADAKKATHARA

The extent of pest infestation and their seasonal abundance have to be reported for all the major pests. Data are to be collected from a minimum of 12 individual trees which are not sprayed with any insecticides throughout the year. Fortnightly/monthly observations have to be recorded in the proforma Nos.1 to IV. The extent of parasitisation should be studied at fortnightly/monthly intervals by observing at least 50 host insects.

Four quadrants (0.5 x 0.5m) are to be marked on each tree on the four sides and the leaders in each quadrant are to be tagged and total number of shoots recorded in each leader. The intensity of infestation and incidence of various pests are to be recorded in each leader.

Tea mosquito infestation was very low on regular flushes during October-November and December months (Table 97). But the infestation on panicle was very high and the mean infestation reached upto a maximum of 47.34 per cent in March. The mean scoring on panicles ranged from 0.50 to 1.80 Maximum nut infestation of 11.67 per cent was recorded during March 1993.

Table 96. Survey of pest complex in different plantations in West Bengal (Jhargram)

Sl. No.	Common name	Scientific name	Month of occurrence	Intensity
1.	Tea mosquito	<u>Helopeltis antonii</u>	Oct-Apr.	Moderate to high
2.	Stem & root borer	<u>Placaederus ferrugineus</u>	Throughout yr.	Moderate to high
3.	Shoot and blossom webber	<u>Lamida monocusalis</u>	Jul-Mar	-do-
4.	Leaf minor	<u>Conopomdiptia synoramma</u>	Aug-Feb	Moderate
5.	Thrips	<u>Rhipiphorethrips cruentatus</u>	Jan-Apr	Low to Moderate
6.	Bark borer	<u>Inderbela tetraonis</u>	Oct-Mar	Low
7.	Shoot tip caterpillar	<u>Hypotime haligramma</u>	Oct-Mar	Low to Moderate
8.	Termite	<u>Odontotermis obesus</u>	Oct-May	Moderate
9.	Apples and nut borer	<u>Nephopteryx</u> sp.	Feb-May	Low
10.	Hairy caterpillar	<u>Estigmene lictinea</u>	Oct-Feb	Low
11.	Leaf beetles	<u>Mylocerus discolor</u>	Jul-Nov	Low
12.	Weevils	<u>Apion ambium</u>	Aug-Nov	Low
13.	Leaf twisting weevil	<u>Apoderus tranquebericus</u>	Aug-Nov	Low
14.	Aphid	<u>Toxoptera odinae</u>	Jan-Mar	Low
15.	Leaf folder	<u>Caloptilia tiselaea</u>	Jul-Feb	Low
16.	Chefer beetles	<u>Holotrichia serate</u>	Feb-Apr	Low
17.	Black ant	<u>Campocotus</u> sp.	Throughout yr.	Low
18.	Red ant	<u>Oecophylla smaragdina</u>	-do-	Low
19.	Gundhi bug	<u>Leptocoris acuta</u>	Nov-Mar	Low
20.	Mites	<u>Oligonychus acuta</u>	Nov-Apr	Low
21.	Membracid bug	<u>Leptocentrus</u> sp.	Oct-Apr	Low

Table ctd.....

Table (ctd.....)

22. Pentatomid bug	<u>Nezara viridulata</u>	Jan-Mar	Low
23. Slug caterpillar	<u>Letoia levide</u>	Nov-Feb	Low
24. Semi looper	<u>Thalassodes quadraria</u>	Nov-Feb	Low
25. Caterpillar	<u>Metanastria hyrtica</u>	Oct-Feb	Low
26. Gresshoppers (3)	Unidentified	Jul-Feb	Low
27. Mealy bugs	<u>Planococcus citri</u>	Jan-May	Low to moderate
28. Coreidae bugs (2)	Unidentified	Nov-Apr	Low

Natural enemies of cashew pests

<u>Parasites/predators</u>	<u>Host</u>	<u>Month</u>	<u>Intensity</u>
1. <u>Bracon brevicornis</u>	Shoot & blossom webber	Oct-Feb	Moderate
2. <u>Apanteles sp.</u>	-do-	Oct-Feb	Low
3. <u>Tachinid parasite</u>	-do-	Nov-Feb	Low
4. Black ant	Leaf minor	Oct-Dec	Low
5. Coccinellid beetle (3)	Aphid	Jan-Mar	Low
6. Spider (6) (unidentified)	Shoot & blossom webber	Nov-Jan	Moderate

Table 97 Monthly occurrence of Tea mosquito (Madakkathara)

Months	Shoot		Panicle		Nut	
	Percent	Mean score	Per cent	Mean score	Percent	Mean score
<u>1992</u>						
Apr.	-	-	No fresh attack		5.50	0.17
May	-	-	-	-	-	-
Jun.	No flushing		-	-	-	-
Jul.	-	-	-	-	-	-
Aug.	-	-	-	-	-	-
Sep.	-	-	-	-	-	-
Oct.	2.08	0.06	-	-	-	-
Nov.	4.72	0.15	-	-	-	-
Dec.	12.73	0.37	17.53	0.50	-	-
<u>1993</u>						
Jan.	-	-	36.56	1.40	10.15	0.35
Feb.	-	-	45.00	1.75	8.89	0.32
Mar.	-	-	47.34	1.80	11.67	0.42
Mean of 12 observations						

The stem borer infestation ranged from 3.43 to 11.60 per cent (Table 98). A low to moderate infestation was noticed in the case of minor pests like leaf miner, leaf roller, blossom webber, apple and nut borer and flower thrips. The period of occurrence and the intensity of infestation is also presented in Table 98.

Ants and spiders were present round the year. However population was maximum during the flowering season (Table 99). Likewise honey bees were present only during fruiting stage. Some types of flies and wasps were present during all the seasons. The important predators noticed during the flowering season were the mirid bugs and chrysopa.

Survey was conducted in private plantations in the Quilon, Palakkad and Thrissur districts during 1992-93. Tea mosquito infestation was found to be high in Palakkad district. In Quilon district tea mosquito infestation was

Table 98. Seasonal occurrence of minor pests and stem and root borer (Madakkethara)

Months	Leaf miner	Leaf roller	Blossom webber	Flower beetles	Apple & nut borer	Flower thrips	Stem borer
	Shoots affected (%)	Shoots affected (%)	panicles affected (%)	(No./panicle)	nut borer (%)	Nuts affected (%)	Mean score
1992							
Apr.	--	-	-	3.66	4.00	22.67	0.77
May.					4.67		5.68
Jun.							3.43
Jul.							4.00
Aug.							4.00
Sep.	15.30	28.20	8.61				3.58
Oct.	20.23	30.51	10.25				4.00
Nov.	12.10	20.00	9.34	12.00			3.53
Dec.	8.72	25.00	5.17	12.50			3.66
1993				3.20			
Jan.	8.00	20.50		7.82	3.20	5.20	0.18
Feb.				10.20	4.75	15.31	0.40
Mar.				10.43	8.51	18.27	0.54
							11.60

Mean of 12 observations

Table 99. Seasonal occurrence of natural enemies and pollinators (Madakkathara)

Months	Mean number per quadrant				Honey bees, flies and wasps
	Ants	Spiders	Mirid bug (nymphs+ adults)	Chrysopa larvae	
<u>1992</u>					
Apr.	0.81	0.40	0.08	0.19	1.13
May.	0.50	0.52		0.25	0.46
Jun.	0.25	0.25			0.25
Jul.	0.20	0.30			1.20
Aug.		0.20			1.00
Sep.	0.75	0.33			0.25
Oct.	1.25	1.25			1.25
Nov.	1.52	1.60			2.00
Dec.	2.00	2.00	3.10	4.00	2.25
<u>1993</u>					
Jan.	2.70	2.78	4.28	4.58	2.00
Feb.	2.53	5.17	7.92	7.34	5.89
Mar.	1.30	4.85	6.00	3.50	5.00
Mean of 12 observations					

low. In the plantations where phytosanitary measures were not adopted the stem and root borer infestation was found to be higher (Table 100).

VRIDHACHALAM

During the period, periodical surveys were made in different places of South and Trichy districts to record the seasonal occurrence, damage potential of cashew pests and their natural enemies besides new pests (Table 101).

Table 100. Survey of insect pest infestation in private plantations
(Madakkathara)

Sl. No.	Common name	Scientific name	Month of occurrence	Intensity
1.	Tea mosquito	<u>Helopeltis antonii</u>	Apr. 93	Low 8.75%
2.	Leaf roller	<u>Angreca albomaculata</u>		Low
3.	Leaf miner	<u>Conopomorpha syngamma</u>		Low
4.	Stem and root borer	<u>Plocaederus ferrugineus</u>		Low 5.00%
5.	Spiers wasps/Honey bees/Ants			Present
C.				
Districts/Taluks/Village surveyed				
Quilon/Pathanapuram Anchal		Tea mosquito leaf roller leaf miner	Apr. 93	Low 8.75% Low Low 5.00%
Quilon/Chirayinkil Pallickal		Tea mosquito Stem & root borer	Apr. 93	Low 7.93% Moderate 6.40%
Palakkad/Ottappalam Nagalassery		Tea mosquito Stem & root borer Leaf roller Flower beetles	Mar. 93	Moderate 26.85 High 18.72 Low 6.25 3.20
Thrissur/Mullekkara		Tea mosquito Stem & root borer Ants	Mar. 93	Moderate 12.85 Low 2.31 Low

Table (ctd....)

Sep. 92	Maligampattu Kadampuliyur Muthandikkuppam	Stem & root borer Ash weevil	0.93- 6.25 0.4- 2.70	Only the stem and root borer was noti- ced in severe in these places parti- cularly at Maligam-
				pattu. The reason is that the farm could not take control measures even if the tree is infested
	Andimadam Kovathur Kallackur	Shoot & root borer Shoot webber Ash weevil	0-4% 4.8- 10.40	Ash weevil damage was severe on young shoot- ots. Andimadam areas recorded high incide- nce to stem and root borer and most of the trees are at middle stage of infestation
	Vridhachalam	Stem & root borer Ash weevil Shoot & blos- som webber	4.67 6.8 8.3	Second broad emergen- ce of shoot webber was noticed
	Neyveli	Stem & root borer Ash weevil	4.88- 5.00 6.4- 10.48	Ash weevil incidence was noticed on emer- ging young flushes on receipt of Jul. Aug. rains
Nov. 92	Neyveli Vadalar Kurinjipadi	Stem & root borer Ashweevil	5.0- 6.75 0-3	Tea mosquito was no- ticed on neem tree also. An average of 5 eggs and 7 nymphs of tea mosquito per ten shoots.
Dec. 92	Kattukodalur Vridhachalam Muthandikuppam Muthandikuppam Andimadam Kovaltur Udayarpalayam	Stem & root borer Tea mosquito Tea mosquito Ashweevil Leaf miner Leaf folder	2.0- 6.0 0-28.8 28.8 0-1.64 0-3 0-2	
Jan. 93	Neyveli Vadalar Kadampuliyur	Stem & root borer Shoot tip ca- terpillar Leafminer Tea mosquito	1.1-6.9 4.65- 24.3 0-74 4.62- 21.88	In all the places on- ly about 20% of the trees were at flushi- ng stage

Table ctd.....

Table (ctd...)

Feb. Vridhachalam 93	Stem & root borer	0-7.5	The damage due to tea mosquito on
	Tea mosquito	0-7.4	neem tree was com-
	Shoot tip		pletely nil
	caterpillar	0-17.5	
Mar. Vridhachalam 93	Teamosquito	0-50	
Andimadam	Shoot tip		
	caterpillar	0-15	

During the period, the pests viz., stem and root borer, shoot and blossom webber, ash weevil, flower thrips and leaf thrips were noticed. During April as the gardens are at final phase of flowering and fruiting, the damage due to flower thrips, tea mosquito and apple and nut borer were noticed. But in June, shoot and blossom webber and leaf thrips were recorded. The incidence due to shoot and blossom webber was continued upto July 1992. Thereafter, ash weevil only was recorded ^{during} flowering. Regarding the stem and root borer, it was recorded in all months of the year and severe in places like Vridhachalam, Andimadam, Neyveli, Vadalur and Melligampattu. Most of the trees are at middle stage of infection.

Natural enemies

During April 1992, Campylomma livida a predator of flower thrips was noticed on panicle (0-17/panicle) wherever the flower thrips population are high. The parasitism due to Apanteles colamani on the larvae of shoot and blossom webber was recorded during reporting period. This project is being continued for further observation.

VENGURLA

The bioecology of the mealy bugs and flower thrips were studied since 1986 and already reported in annual report of 1988-89 and 1990. Regarding seasonal incidence of flower thrips, the minor outbreak was also observed on vegetative buds during rainy season. However, incidence was observed in the month of October-November on leaf petioles. However, major outbreak was observed after fruit setting during December to March.

Survey of pest complex and natural enemies:

The survey of the pests infesting cashew in Sindhudurg district of Maharashtra and seasonal distribution is given in Table 102.

Table 102. Survey of pest complex and natural enemies (Vengurla)

Common name	Scientific name	Month of occurrence	Intensity
Tea mosquito	<u>Helopeltis antonii</u>	Aug to Nov- Dec. Jan-Mar Apr	Low Severe, mod.
Stem and root borer	<u>Plocaederus</u> sp.	Throughout the yr.	Low
Leaf eating beetles	<u>Coenobius</u> sp. <u>Monolepta</u> sp.	Jul-Aug	Low
Leaf cutting weevils	<u>Deporus marginatus</u>	Jul	Low
Leaf minor	<u>Acrocercops</u> <u>syng- rama</u>	Jul-Aug Oct-Nov Feb-Mar	Low
Flower thrips	-	Jul Oct-Nov Dec	Low Low Moderate
Aphids	<u>Taxoptera odinae</u>	Dec	Low

Table ctd.....

Mealy bugs	<u>Ferrisia virgata</u>	Feb-Mar Throughout the yr.	Low Sporadi- cally Low
Apple and nut borer	<u>Planococcus sp.</u> <u>Mephoteryx sp.</u>	Jan-May	Low
Leaf eating looper	<u>Thalassodes sp.</u>	Jul-Aug Feb-Mar	Low Low
Tree hopper		Sep-Oct	Low
Leaf hopper	<u>Amrascus sp.</u>	Jul-Aug	Low
Hairy caterpi- llar		Feb-Mar	Low
<u>Natural enemies</u>			
Lady bird beet- les		Jan-Feb	High
Pyeying mantids		Throughout the yr.	Low
Crysopa		Jan-Feb	Moderate
Spiders (..sp.)		-	-

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

(Bapatla, Bhubaneswar, Chintamani, Jhargram, Madakkathara, Vridhachalam and Vengurla)

The objective of the experiment is to identify germplasm accessions tolerant/resistant to the pests.

BAPATLA

Existing germplasm was categorised in four age groups and screening for resistance or tolerance was worked out for three crop seasons i.e. 1990, 1991 and 1992. Data on the average population of pests over three years (1990-1992) on 17 types were recorded against weevils, leaf miner and Hypotima haligramma, L.moncusalis and Nephoteryx sp. (fruit feeders)

Average population of weevils for three years was recorded during February, i.e. at the time of panicle emergence stage. Minimum population per quadrant was recorded in types 274L, 286, 244, 232 and 231 ranging from 0.0 to 1.0.

Maximum population (3.8 and 4.0) of leaf miner was recorded in T.No.232 and 71 showing their tolerancy. On the other hand, T.No.277 and 1 recorded maximum susceptibility to Hypotima haligramma in flowering stage and tolerancy in T.No.228 and 232.

BHUBANESWAR

The '18' MLT entries were screened against the shoot tip caterpillar Hypotima haligramma Mey., the major pest of cashew at this centre under field condition. The results indicated that the type 1608 showed the lowest damage of 8.40 per cent. shoot infestation followed by type

30/4 (14.46%). The cultivar 44/3, BPT 2/16, 1610 and M 33/3 were moderately affected (the per cent shoot infestation vary from 16.83 to 19.61). The remaining types showed more than 20 per cent shoot infestation with the maximum of 35.51 per cent in var. M 26/2.

CHINTAMANI

All the remaining germplasm and the accessions in multilocation trial were screened for tea mosquito and other foliage pests. Since the population of all the major pests were very low, the difference among accessions was very negligible. No conclusion can be drawn. The accessions 1598, 1600, 1610, H/26, 5/37, 4/48, 1/84 and 9/88 were less susceptible to inflorescence thrips and fruit and nut borer.

JHAPGRAM

Field confinement test: To identify germplasm accessions tolerant/resistant to the pest, this experiment was conducted in the field. The types M 44/3, 10/4, TN-58, VTH-59, H-1600, H-1610 were rescreened under field confinement test. In addition to this, 16 germplasm types were also screened against tea mosquito and minor pests, None of them were found resistant to tea mosquito.

MADAKKATHARA

All the accessions planted during 1988 (Acc. No.15 to 50) and 1989 (Acc. No.51 to 82) were observed at monthly

intervals and recorded the tea mosquito infestation. A moderate to heavy infestation by tea mosquito could be noticed on the flushes produced during the monsoon period. The level of infestation was also recorded at monthly intervals (percentage shoot infestation and mean score) during June, July and August. Maximum shoot infestation of 51.70 per cent was noticed in the accession H-8-10 and the minimum was (4.78) in Bzl. 3. No infestation could be noticed in accessions H-856, H-1588 and H-1589. The shoot infestation was found to be less on the hybrids (Acc. No. 40 to 46) and in the accessions UL-12-2, Bzl-18, K-3-1, K-3-2, K-4-1, K-4-2.

In most of the accessions the shoot infestation was comparatively low during the regular flushing in October-November. Though the extent of infestation was low on panicles during the early phase of flowering, subsequently the infestation was high during February-March. The mean infestation from October to April was also observed. The accessions which have recorded a mean infestation of less than 25 per cent and produced yield are: Bzl-120, Bzl-239, Bzl-244, Anakkeyam-1m, Medakkathere-1, K-22-1, H-3-13, H-3-17, H-680, H-682, H-719, H-1596, H-1597, H-1598, H-1600, H-1602, H-1608, H-1610, M-1-2, A-26-2, K-16-1. These accessions were comparatively tolerant to tea mosquito infestation. Highest mean yields of 1.74 and 1.73 kgs were recorded in H-719 and A-26-2. In the case of the accessions planted in 1989 the flowering was late and the panicle infestation was very high and yield could not be obtained.

VRIDHACHILAM

During the flowering season of 1992, the 1987 planted F-1 hybrids of high yielding cashew were observed for tea mosquito bug tolerance. (Surya, J. The pooled data is

presented in Table 103.

Table 103. Relative damage potential due to tea mosquito bug on the F-1 hybrids (Vridhachalam)

Crosses	Mean per damage*	Mean score of damage*
M 10/4 x M 26/1	22.1 (28.0)	1.76
M 10/4 x M 45/4	11.5 (19.8)	0.93
M 10/4 x M 45/3	26.3 (30.8)	2.01
M 26/2 x M 26/1	32.0 (34.4)	2.78
M 26/2 x M 45/4	19.4 (26.1)	1.12
M 26/2 x M 45/3	37.0 (27.1)	2.56
M 44/3 x M 26/1	27.8 (31.8)	2.37
M 44/3 x M 45/4	15.4 (23.7)	1.05
CD	5.23	0.72

* Mean of two observations

Figures in parenthesis are transformed values

The results revealed that among the crosses M 10/4 x M 45/4 recorded the lowest damage (11.5%) and score of damage (0.93), and it was on par with M 26/2 x M 45/4 (19.4% and 1.12) and M 44/3 x M 45/4 (15.4% and 1.05). This indicates that all the high yielding types crossed with M 45/4, the already identified less susceptible type, exhibited resistance against tea mosquito bug.

Tea mosquito bug--Laboratory screening:

The types M 45/4 and 99/4 which were found less susceptible under field confinement screening were clonally multiplied along with the susceptible types M 15/4 and screened against tea mosquito bug under controlled cage condition in a cage which can accommodate eight grafts at a time (as designed by the NRCC, Puttur). Two adults per grafts were scored for damage after two days. Totally 10 grafts for each type was screened.

Type	Mean score of damage
M 45/4	2.50
M 99/4	2.83
ME 15/4	3.60

The mean score of damage was 2.50, 2.83 and 3.60 respectively.

Besides all 17 MLT entries were screened against the field incidence of shoot tip and inflorescence caterpillar. The data showed that the entries M 19/1610 (Madakkathara (6.9%), 2/15 (Bapatla) (6.8%), V-4 (Vehgurla) (6.6%), M 33/3 (7.6%), M 26/2 (8.3%) and M 44/3 (7.5%), Vridhachalam (7.5%) have recorded significantly low damage due to shoot tip and inflorescence caterpillar.

During July 1992, all the available germplasm were screened at peak incidence against shoot and blossom webber. Of 119 types M 20/4 was completely free from the incidence and the types M 24/4 (10.93%), M 35/3 (4.30%) and M 104/4 (7.28%) were less affected. The types namely M 30/1, M 1/3, M 100/1 and M 103/4 were highly infected and recorded more than 60 per cent damage.

VENGURLA

Forty eight bold type accessions were screened against tea mosquito during flowering season of 1992-93. However none of the types observed were found resistant to tea mosquito.

CHAPTER-II: ORGANIZATION

(a) HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices & Cashewnut Improvement Project was started during the Fourth Five Year Plan in 1971 in which five centres (four University centres and one ICAR-Institute based Centre) were identified for conducting research on Cashew. These centres were located in Andhra Pradesh (Bapatla); Tamil Nadu (Vridhachalem); Kerala (Anakkayam), Maharashtra (Vengurla) and Karnataka (Central Plantation Crops Research Institute, Regional Station, Vittal). During the Fifth Plan period, one more centre in Orissa (Bhubaneswar) and Sixth Plan period two centres, one in West Bengal (Jhargram) and another in Karnataka (Chintamani) were added. The Project Coordinator's Cell was located at Central Plantation Crops Research Institute, Kasaragod. During the Seventh Plan period, the Project is bifurcated into All India Coordinated Cashew Improvement Project and All India Coordinated Spices Improvement Project (vide ICAR Office Order F.No.4-1/80-H&MC dated 24 September 1985). The Project Coordinator's Cell has been shifted to newly established National Research Centre for Cashew, Puttur. The main objectives of the project are:

- * Evolving high yielding varieties tolerant/resistant to pests and diseases
 - * Standardizing agro-techniques for crop under different agroclimatic conditions
- and
- * Evolving efficient pest and disease management techniques

The first Workshop of AICSICIP was held at Kasaragod in December 1971 in which the research

programmes were drawn up. Subsequently the progress of work was reviewed in Workshops held in 1972 (Kasaragod, Kerala); 1975 (Coimbatore, Tamil Nadu); 1978 (Goa); 1981 (Trichur, Kerala); 1983 (Calicut, Kerala); 1985 (Trivandrum, Kerala); 1987 (Bhubaneswar, Orissa) and 1989 (Coimbatore, Tamil Nadu). In 1991 in lieu of Biennial Workshop, a National Group Discussion of Cashew Research Workers was held at CPCRI Kasaragod (Kerala) during August-September 1991. The significant achievements of the Project are summarized below:

(1) A total of 21 varieties were released by various Coordinating centres for cultivation in the respective regions (All centres except Chintamani)

(2) For commercial multiplication of elite cashew varieties, soft wood grafting was standardized with a success percentage ranging between 62 and 83 (Vengurla, Bapatla, Bhubaneswar, Madakkathara and Vridhachalam)

(3) During off-season, flush grafting was standardized under Kerala conditions (Madakkathara)

(4) Top working for upgrading genetically inferior plants of 15 to 20 years using soft wood grafting technique was demonstrated (Bapatla, Bhubaneswar, Madakkathara and Vengurla)

(5) Fertilizer requirement of cashew crops was worked out to be 500g N, 125g each of P_2O_5 and K_2O (Bapatla, Vengurla, Madakkathara and Vridhachalam)

(6) Application of 600g N, 250g P_2O_5 and 250g K_2O is found to be beneficial in doubling the yield in

the second year of application for nine year old cashew trees, which were never fertilized before (Jhargram)

(7) Fertilizer application in circular trench of 25 cm broad, 50 cm depth at 1.5m from the trunk was found to be beneficial in sandy loam laterite and in slopy lands. However, in low rainfall zone, fertilizer application in an area of 1.5 m width between 1.5 and 3.0 m from the trunk and incorporating into the soil was found to be best (Bapatia, Vengurla, Vridhachalam and Medakkathara)

(8) For control of tea mosquito bug and other foliage and inflorescence pests spraying of endosulfan, quinalphos and monocrotophos found to be effective (all the seven Coordinating centres)

(9) Application of coal tar + kerosene in 1:2 and 1:4 ratios was found to be promising prophylactic treatment for stem and root borer (Vridhachalam)

(10). For curative treatment, application of 10% BHC dust-500g and Phorate-150g followed by monocrotophos 0.06% spray on trunk was found to be superior in getting 80 per cent recovery of the infested trees (Bapatia)

(b) STAFF POSITION

Project Coordinator	Dr. EVV Bhaskara Rao
Technical Information Officer	Dr. K. Palanisamy (Upto 21-8-1992)
Stenographer	Shri V. Ahamed Bava

PROJECT CENTRESCashew Research Station, Bapatla 522 101 (APAU), Andhra Pradesh

Horticulturist	Dr. K.Pampapathy
Asst. Entomologist	Mrs. M. Rema Devi
Asst. Agronomist	Mr. Y. Radhakrishna
Sr. Technical Assistant	Vacant
Jr. Technical Assistant	Sri I. Musalaiah (upto 31-8-92) Sri K. Rangha Rao (from 3-9-1992) Sri Ch. Rama Rao
Attender	Sri G. Jaya Rao (from 29-04-1992)

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

Horticulturist	Mr. PC Lenka
Jr. Entomologist	Mr. LN Mohapatra
Jr. Technical Assistant	Mr. RC Routray

Agricultural Research Station, Chintamani 563 125 (UAS) Karnataka

Horticulturist (Agron.)	Sri KS Krishnappa
Jr.Horticulturist	Sri V.Shankarenerayana
Jr.Entomologist	Sri GT Thirumalaraju
Sr.Technical Assistant	Sri TN Venkatesha Gowda Shri VL Madhuprasad (from 29-9-1992)

Regional Research Station, Jhargram 721 514 (BCKV)
West Bengal

Jr. Horticulturist	Dr. Jitesh Kumar Hore
Jr. Entomologist	Dr. B. Bandopadhyay
Jr. Technical Assistant	Sri S. Dutta Roy

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

Assoc. Professor (Agron.)	Sri TN Jagadeesh Kumar (Asst. Professor)
Asst. Professor (Ento.)	Dr. S. Pathummel Beevi (Assoc. Professor)
Sr. Technical Assistant	Mrs. KE Usha (from 01-02-1992) (Jr. Asst. Professor)
Jr. Technical Assistant	Sri C. Girishan

Regional Fruit Research Station, Vengurla 416 516 (TKV)
Maharashtra

Horticulturist	Sri DP Sawke
Jr. Entomologist	Sri SK Godse
Jr. Breeder	Sri SB Deshpande
Jr. Technical Assistant	Sri RL Mayekar

Regional Research Station, Vridhechalem 606 001 (TNAU)
Tamil Nadu

Horticulturist	Dr. H. Ahmed Shah
Jr. Horticulturist	Sri S. Subramenian
Jr. Entomologist	Sri T. Senguttuvan (upto 17-2-93) Sri S. Gopal (from 18-2-93)
Sr. Technical Assistant	Vacant
Jr. Technical Assistant	Sri S. Manikkam

(c) BUDGETARY ALLOCATION AND EXPENDITURE DURING 1992-93:

(Rs. in Lakhs)

Centre	Pay & Allow.	T.A.	Recur- ring Contingency	Non-recur- ing	Total	ICAR Share
BAPATLA	3.59	0.10	0.60	0.45	4.74	3.56
BHUBANESWAR	1.72	0.10	0.40	0.45	2.67	2.00
CHINTAMANI	2.44	0.10	0.60	0.45	3.59	2.69
JHARGRAM	1.43	0.10	0.40	0.45	2.38	1.79
MADAKKATHARA	2.11	0.10	0.60	0.45	3.26	2.44
VENGURLA	2.40	0.10	0.60	0.45	3.55	2.66
VRIDHACHALAM	2.66	0.10	0.60	0.45	3.81	2.86
TOTAL:	16.35	0.70	3.80	3.15*	24.00	18.00

*Mist Propagation Units

ACTUAL EXPENDITURE

BAPATLA	3.08	0.07	0.60	--	4.33	3.25
BHUBANESWAR	2.21	0.08	0.50	--	2.79	2.09
CHINTAMANI	2.52	0.08	0.60	--	3.20	2.40
JHARGRAM	1.34	0.09	0.31	--	1.74	1.30
MADAKKATHARA	2.66	0.08	0.66	0.45	3.85	2.89
VENGURLA	2.78	0.10	0.60	--	3.48	2.61
VRIDHACHALAM	2.78	0.07	0.60	0.18	3.63	2.72
TOTAL:	17.95	0.57	3.87	0.63	23.02	17.26

(d) MONITORING OF PROJECT BY COORDINATOR

The programmes to be implemented in different centres was decided during the National Group Discussion of Cashew Research Workers held at CPCRI Kasaragod during 30-31 August and 1st September 1991. The visit by Project Coordinator to different centres was as follows:

13-04-1992.....	CHINTAMANI
07-05-1992.....	VRIDHACHALAM
30-10-1992.....	MADAKKATHARA
26-11-1992.....	BHUBANESWAR
27-11-1992.....	JHARGRAM
15-02-1993.....	VENGURLA
22-03-1993.....	BAPATLA

During the visit to the centres, the programme allotted to each of the Centre was reviewed along with inspection of the field experiments. University authorities were also contacted to appraise the progress of Centre and also for sorting out the centre's constraints. During the visit to different States, I have also visited the Corporation/ Departmental plantations for identifying the constraints for production in plantations in that area and gave necessary technical advice for overcoming the production constraints. During the visit to the centres, the grafts production and availability of grafts of released varieties was reviewed and based on the information collected, the supply of grafts to different development departments for taking up centrally sponsored/central sector schemes was coordinated.

Reports received from the centres in the Project Coordinator's Cell was critically reviewed and comments sent to concerned centres for necessary action. For easy retrieval of the Project information, technical programmes, staff position, budget allocation and monitoring of expenditure, the computerised data base established at NRC Cashew, Puttur was updated.

(B) FUNCTIONING OF EACH CENTRE

BAPATLA (APAU):

The Centre was allotted the technical programmes in Crop Improvement which included germplasm collection, multilocation variety evaluation trial, hybridization and selection. The centre has multiplied T.No.30/1, 3/33, 10/90 and 3/28 for supplying the material to other Coordinating centres for laying out the New Multilocation trial. However, it is yet to collect grafts for MLT-92 from other centres. The centre has also supplied 'Rajahmundry accession' scion sticks to other Coordinating centres. During the year 15,600 grafts were produced for supply to different agencies and farmers. Top working trial is in progress. Standardization of index leaf for determining the nutrient status is in progress only at this Centre. However, inconsistency in leaf nutrient levels was noticed in the report submitted and the experiment was asked to be repeated. All the five experiments in Crop Protection were carried out as per the technical programme allotted during the National Group Discussion of Cashew Research Workers. The centre's performance is assessed as satisfactory.

BHUBANESWAR (OUAT):

Bhubaneswar Centre has identified ten elite types and the same were collected and added to the available germplasm. Out of these, eight accessions were reported to be cluster bearing types. In the multilocation variety evaluation trial, the growth of the plants is satisfactory and instead of three replications, centre was asked to consolidate the available plants and continue the experiment with only two replications. In vegetative

propagation, flush grafting was also tried as per the Workshop decision. However, success reported is only 40 per cent and the experiment need to be repeated. The centre has produced 2000 grafts for distribution to farmers and different agencies. The trial on Cashew based Cropping systems with perennial plants is being undertaken as per the approved programme. In an experiment on foliar application of urea (3%) along with soil application of 500g N, 250g each of P_2O_5 and K_2O gave the highest yield.

For major portion of the period under report, the Jr. Entomologists post was vacant (Jr. Entomologist was posted only on 24-7-1992) and hence in entomology, experiments on bio-ecology of the pests of regional importance and screening of germplasm were not conducted. However, the chemical control trials on the minor pests, and stem and root borer were taken up as per the approved programme. The performance of the Centre is assessed as satisfactory

CHINTAMANI (UAS):

All the experiments allotted to the Centre were taken up as per the approved technical programme. During the year 20 new accessions were collected by the centre and added to the germplasm collection; two multilocation variety evaluation trials are in progress at this centre and the grafts for the MLT-92 were also collected by the centre for laying out the trial. Veneer grafting and flush grafting which were suggested were also taken up. However, the success reported is very low and the experiment need to be repeated. Revised doses of NPK as per the Workshop decision were imposed during the year. Linear response to nitrogen application was confirmed.

In Plant protection, all the four experiments allotted to the Centre were carried out as per the technical programme. The centre's performance is assessed as satisfactory.

JHARGRAM (BCKV):

During the year the Entomologist's post which was vacant, was filled up. All the approved programmes in Crop Improvement are taken up. However germplasm collections from Purulia and Bankura districts is yet to be completed. The centre has collected the grafts for the new multilocation trial from Vengurla and yet to collect the grafts from other coordinating centres. The centre was instructed to collect the grafts and lay out the trial during the current season itself. In propagation trial good success were reported in in-situ grafting. However, in soft wood grafting the success percentage was limited to two months in a year only. In Agronomy, experiment on foliar application of urea along with insecticides with the revised treatments was taken up by the centre. This is the only centre where the spacing trial is in progress and thinning of the plants as per the approved technical programme was completed.

In Crop protection chemical control of pest complex, control of stem and root borer were taken up. The performance of the Centre is assessed as satisfactory.

MADAKKATHARA (KAU):

The centre has expressed difficulty due to the non-availability of land for laying out the new trials. After repeated discussions with the University officials it has now been possible to identify the land for allotment to the Centre. The University has agreed to

clear the old rubber plantations and made available the land for laying out the new MLT-92 and NPK experiment. In the germplasm, 19 accessions have been maintained in the conservation blocks. Centre has also identified two new hybrids H-1598 and H-1608 as the high yielders with bold nuts. Multilocation trial is in progress. However, the centre is yet to initiate the hybridization programme as per the decision of the National Group Discussion. The centre has taken up commercial production of grafts during the year and has produced 16 200 grafts during the year.

Centre has conducted all the Plant protection experiments as per the approved technical programme. However, the University is yet to clear the area and made available to the Centre for laying out the new MLT and hybrids produced at this Centre.

VENGURLA (KKV):

In the germplasm collection, the centre has made the best efforts in collecting bold nut types from Maharashtra area. Multilocation trial with 17 varieties is being conducted as per the approved programme. Centre has also multiplied the varieties identified for MLT-1992 and supply the grafts to other Coordinating centres. Hybridization programme taken up at this Centre is the most systematic among all the other centres. Centre has got the best infrastructure facilities for graft production. During the year a total of 107,000 grafts were produced for distribution to development agencies and farmers. In top working trial in the third year, top worked tree has yielded 8 kg of nuts. In Agronomy, the centre has laid out the intercropping trial with fruit trees and also the NPK experiment with V-4 types.

In Plant Protection all the experiments allotted to the Centre are in progress. The centre's performance is good.

VRIDHACHALAM (TNAU) :

Centre has taken up germplasm survey and collection of cluster bearing and thin shell types. In the variety evaluation trial all the 17 varieties were established and the performance of Vengurla and Bapatla types was found to be promising. Centre has also taken up hybridization with tea mosquito bug tolerant types identified at the Centre. In vegetative propagation the centre has taken up soft wood grafting, veneer grafting and flush grafting. However, the success reported is very low. During the year the Centre has produced 2819 grafts for distribution to farmers and development agencies. In top working trial the mortality of the trees after six months was reported. In Agronomy the centre has laid out cropping systems trial during the current season. In Crop protection the Centre has implemented all the technical programmes in the five experiments allotted to the Centre. Centre's performance is assessed as satisfactory.

(f) PROBLEMS IN FUNCTIONING DURING THE YEAR

One of the general problems experienced by the Scientists of the Centre is lack of Grafters for taking up propagation work.. The casual labourers does not have required skill. Even if a person is trained, he may not be available continuously in the grafting season as he is employed on casual basis. While clearing the EFC of VIII Plan the post of Grafters proposed for each of the Centre has been approved. However, the posts sanctioned are yet to be filled up.

(g) METEOROLOGICAL DATABAPATLA

Month	Temperature (°C)		Relative humidity(%)		Rainfall (mm)	No. of rainy days
	Max.	Min.	AM	PM		
Apr. 92	33.7	24.8	74.0	70.0	2.2	1
May.	36.8	27.5	66.0	63.0	18.2	3
Jun.	36.5	23.2	66.0	56.6	83.0	5
Jul.	35.6	20.1	72.0	57.0	64.9	8
Aug.	33.6	25.1	77.0	67.0	125.7	13
Sep.	32.7	24.8	82.0	73.0	202.8	16
Oct.	32.7	23.8	82.0	73.0	51.4	6
Nov.	29.7	21.9	90.0	78.0	226.2	8
Dec.	29.1	16.8	90.8	61.7	--	--
Jan. 93	29.6	16.8	93.0	65.0	--	--
Feb.	30.7	17.9	89.0	61.0	--	--
Mar.	32.6	22.4	82.0	66.0	74.4	60

BHUBANESWAR

Apr. 92	30.7	23.7	86.0	44.0	11.0	3
May.	36.3	25.5	87.0	60.0	251.4	9
Jun.	35.4	25.4	89.0	64.0	138.2	13
Jul.	32.4	25.2	90.0	79.0	354.0	19
Aug.	32.1	24.1	91.0	78.0	356.3	21
Sep.	32.9	24.5	92.0	74.0	225.9	13
Oct.	32.7	22.5	90.0	64.4	163.9	8
Nov.	30.9	19.7	83.0	53.0	1.3	3
Dec.	29.2	13.6	92.0	37.0	--	--
Jan. 93	30.5	15.6	89.0	39.0	--	--
Feb.	32.6	17.8	89.0	37.0	--	--
Mar.	35.1	21.6	87.0	43.0	9.7	5

CHINTAMANI

Month	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	No. of rainy days
	Max.	Min.	AM	PM		
Apr. 92	35.7	19.6	59		34.8	2
May.	35.4	-	60		43.8	4
Jun.	31.8	-	68		152.2	8
Jul.	31.6	-	67		30.8	3
Aug.	29.0	19.0	71		97.0	4
Sep.	30.6	19.6	69		54.6	3
Oct.	29.5	18.1	70		118.2	10
Nov.	28.5	16.6	69		56.6	7
Dec.	28.0	11.9	64		---	--
Jan. 93	28.3	17.3	52		---	--
Feb.	31.5	18.4	52		---	--
Mar.	33.2	23.2	67		---	--

JHARGRAM

Apr. 92	34.3	23.5	78.8	51.0	58.2	5
May.	36.6	24.3	80.6	53.1	97.8	13
Jun.	34.0	25.2	83.4	63.4	375.2	11
Jul.	32.2	25.0	88.5	80.8	421.4	20
Aug.	31.4	25.3	87.9	83.0	226.8	16
Sep.	31.7	25.8	84.9	80.6	170.8	10
Oct.	31.2	26.6	84.5	68.3	88.4	6
Nov.	30.3	17.5	84.5	56.3	2.0	1
Dec.	26.4	11.8	81.5	53.0	---	--
Jan. 93	25.9	12.6	76.7	46.4	---	--
Feb.	30.0	15.0	72.2	36.5	---	--
Mar.	32.2	18.8	71.4	36.7	16.4	4

MADAKKATHARA

Month	Temperature (°C)		Relative humidity(%)		Rainfall (mm)	No. of iny days
	Max.	Min.	AM	PM		
Apr. 92	36.3	24.4	65		48.6	3
May.	33.8	24.8	73		90.6	6
Jun.	30.1	23.7	84		979.8	22
Jul.	28.8	22.7	87		874.8	26
Aug.	28.9	23.3	88		562.9	25
Sep.	30.10	23.1	82		302.9	17
Oct.	30.70	22.9	82		386.7	14
Nov.	31.0	23.1	77		376.7	12
Dec.	31.10	22.3	61		2.0	
Jan. 93	32.60	20.70	53		--	--
Feb.	34.10	22.00	62		7.6	2
Mar.	35.40	23.70	63		--	--

VENGURLA

Apr. 92	32.5	22.5	69.4		--	--
May.	33.0	25.5	72.2		49	2
Jun.	31.5	25.0	83.6		889	16
Jul.	29.4	24.5	87.6		933	23
Aug.	27.9	24.1	88.9		684	26
Sep.	30.1	23.7	88.0		160	14
Oct.	31.2	23.0	88.3		37	5
Nov.	33.7	22.3	76.8		27	1
Dec.	32.9	20.0	78.5		--	--
Jan. 93	31.8	20.7	85.1		--	--
Feb.	32.5	21.4	80.6		--	--
Mar.	31.4	24.8	76.6		--	--

VRIDHACHALAM

Month	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	No. of r iny 20
	Max.	Min.	AM	PM		
Apr. 92	40.5	25.6	59	44	--	--
May.	40.2	28.4	60	46	18.6	2
Jun.	40.2	27.5	59	43	71.0	3
Jul.	36.7	27.5	61	47	64.2	7
Aug.	38.3	25.3	74	59	118.8	5
Sep.	34.0	24.9	78	62	110.4	8
Oct.	34.9	25.2	81	70	192.2	9
Nov.	34.1	24.4	85	72	360.5	14
Dec.	31.3	25.3	80	70	81.0	5
Jan. 93	34.5	23.1	78	60	--	--
Feb.	34.0	23.0	70	58	--	--
Mar.	35.4	25.9	62	48	--	--

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