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COORDINATOR'S REPORT

The All India Coordinated Spices and Cashewnut Improvement Project was started during fourth five year Plan in 1971 with the Project Coordinator's Cell at Central Plantation Crops Research Institute, Kasaragod. During the seventh Plan the ongoing Project was bifurcated into two separate projects, one on Cashew and another on Spices. During the same plan period the Coordinator's cell for Cashew was shifted to the newly established National Research Centre for Cashew, Puttur. The All India Coordinated Research Project on Cashew has eight centres and one sub centre of which four were started at the inception of AICS and CIP in the year 1971 (Bapatla-APAU; Anakkayam-KAU presently at Madakkathara; Vengurla - KKV and Vridhachalam - TNAU). One centre at Bhubaneswar (OUAT) during fifth Plan period and two more at Jhargram (BCKVV) and Chintamani (UAS) during sixth Plan period were added. During eighth Plan one centre at Jagdalpur and one sub centre at Pilicode were also started. The Budget allocation of the Project for the year 1995-96 was Rs.31.41 lakhs (Rs.23.55 lakhs ICAR share) and the expenditure was Rs.34.77 lakhs (Rs.26.08 lakhs ICAR share) of which Rs. 4.11 lakhs incurred under the Non-recurring contingency is revalidated amount of allocation made in earlier financial year.

The Projects' mandate is to increase production and productivity through:

1. Evolving high yielding varieties with export grade kernels tolerant/resistant to pests and diseases.
2. Standardizing agrotechniques for the crop under different agroclimatic conditions.

3. Evolving cost effective and efficient pest and disease management practices.

CROP IMPROVEMENT

A total of 994 cashew germplasm accessions (Bapatla-116; Bhubaneswar-84; Chintamani-116; Jhargram-127; Madakkathara-120; Pilicode-15; Vengurla-161 and Vridhachalam-255) are being maintained and evaluated in different centres. During the year a total of 25 new collections showing promising characters were added to the germplasm at different centres. (Bhubaneswar-3; Jhargram-2; Madakkathara-2 and Pilicode-18). Thus, the total collections increased to 1019 in different centres.

The highest nut yield of 13.04 kg/tree was recorded in Vengurla-5 and highest nut weight of 7.01g in Vengurla-3 at Chintamani.

In Multilocation trials, varieties collected from different centres are being evaluated. The highest yield was recorded in H-2/16 (15.7 kg/plant) at Bhubaneswar, M44/3 at Chintamani (11.1 kg/tree) and at Vridhachalam (11.9 kg/tree), VTH 59/2 (7.7 kg/tree) and VTH 30/4 (5.9 kg/tree) at Jhargram; Vengurla -5 at Madakkathara (13.9 kg/tree) and at Vengurla (6.2 kg/tree) during the year. At Madakkathara, the maximum cumulative nut yield (for five years) was recorded in M-26/2 (44.7 kg/tree) and M-44/3 (44.4 kg/tree).

Evaluation of F1 hybrids showed that three hybrids from Bapatla viz. Hy 4/1 (1 x 100), Hy 3/10 (T.No.56 x T.No.40) and Hy 2/15 (Tree No.1 x T.No.40) gave an yield of 19.0

kg, 16.6 kg and 15.2 kg per tree respectively. From Madakkathara, hybrid H-1591 was released as Priyanka which has an yield potential of 16.9 kg/tree, jumbo nut size (over 10g) and kernel of 2.87 g. At Vengurla, H 255 (Vengurla 3 x M 10/4) gave a yield of 18.5 kg/tree. At Vridhachalam, Hybrid-16 (M 44/3 x M 26/1) gave the highest mean yield of 1.53 kg/tree during the year. H 13 (M 26/2 x M 26/1) gave the highest mean yield of 3.58 kg/tree for last six years at Vridhachalam.

CROP MANAGEMENT

A. AGRONOMY :

In NPK trial, application of 1000g N, 250g P and 250g K ($N_2P_2K_2$) per tree per year gave the highest nut yield compared to the control at Chintamani and Bhubaneswar centres. In spacing trial, maximum yield per plant (4.56 kg/tree) was recorded in trees planted in 10m x 5m rectangular system with no thinning of plants while maximum yield/block (63.38 kg/block) was recorded in 6m x 6m x 6m triangular system at Jhargram centre.

In cashew based cropping system trial at Bapatla, cluster bean and cowpea gave an yield of 825 kg/ha and 62.5 kg/ha respectively. Sesamum (380 kg/ha) and horsegram (610kg/ha) were found to be suitable intercrops under rainfed condition at Bhubaneswar whereas blackgram gave an yield of 221.64 kg/ha at Vridhachalam.

In On-farm trial with higher doses of fertilizers, the nut yield has increased from 8.5 kg/tree to 11.2 kg/tree at Bapatla when the dose was doubled.

Trial on high density planting with 625 plants/ha to study the impact of close spac-

ing on yield is initiated using BPP-5 clones at Bapatla centre.

B. HORTICULTURE :

Screening of vigorous and less vigorous cashew types at Madakkathara revealed the possibility of identifying the less vigorous from the more vigorous using morphological and chemical characters at the seedling stage. At Vengurla growth analysis of sixteen rootstocks is in progress.

CROP PROTECTION

Spraying of monocrotophos (0.05%), endosulfan (0.05%) and carbaryl (0.1%) at flushing, flowering and fruiting stage respectively was found effective in controlling tea mosquito bug and minor pests at Jagdalpur, Jhargram and Vengurla centres.

Skipping third spray (at fruiting stage) did not increase the TMB incidence at Jhargram, Vengurla and Madakkathara centres.

The incidence of Tea mosquito bug was least when endosulfan (0.05%) at flowering and neem oil (2%) at fruiting stage was sprayed at Madakkathara centre. The first spray was found crucial in the control of shoot tip caterpillar at Bapatla.

Neem oil (5%) swabbing upto 1m height from the base of the trunk acted as a good prophylactic measures for stem and root borer in Bapatla and Madakkathara centres.

Neem oil (5%) swabbing on the tree trunk and application of sevidol 75 g/tree to the basin were found to be effective against stem and root borer at Bhubaneswar and Jhargram centres.

In the survey for pest incidence and natural enemies, incidence of stem and root borer was existing from low to moderate or moderate to high in east coast and west coast centres. Incidence of tea mosquito bug was recorded in all centres except in Bapatla. However in Andhra Pradesh, in Srikakulam, Visakhapatnam, Vijayanagaram, Godavari districts Tea mosquito bug was recorded. Minor pests like apple and nut borer in all centres except Jagdalpur, leaf miner; leaf and blossom webber in all centres were found to occur in certain seasons/months. In Jhargram, leaf and blossom webber, leaf miner and inflorescence thrips continued to be more injurious than tea mosquito bug in cashew growing tracts of West Bengal.

The important predator noticed were spiders on leaf and blossom webber at

Jhargram centre, and as general predators in almost all centres. At Vridhachalam, there was a direct correlation between damage by tea mosquito bug and weather parameters like temperature and rainfall. At Chintamani it was revealed that maximum temperature and relative humidity were negatively correlated with TMB incidence.

Screening of germplasm to locate tolerant/resistant types to major pests of the region was carried out. H-1600 and OC-11 showed the least infestation for shoot tip caterpillar at Bhubaneswar. Four accessions A-26-2, H-718, H-8-8 and H-3-17 at Madakkathara were found to be comparatively less susceptible to tea mosquito infestation. Over 3.6 lakh grafts of released varieties were supplied by different coordinating centres during 1995-96.

CENTRES OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW



1. CENTRAL RESEARCH STATION FOR CASHEW, PUTTUR 574 202 -- HEADQUARTERS OF PROJECT

2. DIRECTOR'S CELL

3. CENTRAL RESEARCH STATION, (APAU), BAPATLA 522 101, ANDHRA PRADESH

4. CENTRAL RESEARCH STATION, (OUAT), BHUBANESWAR 751 003, ORISSA

5. CENTRAL RESEARCH STATION, (UAS), CHINTAMANI 563125, KARNATAKA

6. CENTRAL RESEARCH STATION, (BCKV), JHARGRAM, SEVAYATAN PO-721 514, WEST BENGAL

7. CENTRAL RESEARCH STATION, (KAU), MADAKKATHARA 680656, KERALA

8. CENTRAL RESEARCH STATION, (KAU), PILICODE 671 353, KERALA

9. CENTRAL RESEARCH STATION, (KKV), VENGURLA 416516, MAHARASHTRA

10. CENTRAL RESEARCH STATION, (TNAU), VRIDHACHALAM 606 001, TAMIL NADU

11. CENTRAL RESEARCH STATION, (IGAU), JAGADALPUR 494 005, MADHYA PRADESH

GENERAL CHARACTERISTICS OF AICRP ON CASHEW CENTRES

Coordinating centres are spread in East Coast, West Coast and Maidan tracts. In East Coast the centres are located in Vridhachalam, Bapatla, Bhubaneswar, and Jhargram. This zone receives low to medium rainfall ranging from 850 mm to 2065 mm annually and distributed over a period from June to December. The soil is mainly sandy and red sandy loam and red loam.

In West Coast the centres are located at Madakkathara, Pilicode and Vengurla. This zone receives maximum rainfall ranging from 2804 mm to 3796 mm annually and distributed from April to December. The soil is typically sandy, red sandy loam and

laterite. Red soil with muram substratum are also found in patches.

Maidan tract is characterised by levelled land with very low rainfall (834 mm) distributed from April to December. The soil is deep and red sandy loam in nature. Rocky patches are also found at the deep layers. The Coordinating centres Chintamani and Jagdalpur fall in this region.

In West coast no rain was received from December 1995 to March 1996. In East Coast and Maidan tract except Vridhachalam centre minimum rain was received from December 1995 to March 1996.

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

Centres :

- East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast : Madakkathara, Pilicode, Vengurla
Maidan tracts : Chintamani

Objectives :

1. To evaluate the existing germplasm collections at different centres
2. To collect local germplasm with desirable characters such as high yield, cluster bearing habit, bold nut, short duration of flowering etc. from different cashew growing areas.
3. To establish clonal germplasm conservation blocks in different centres.

1. Germplasm collection and conservation.

A total number of 994 accessions of cashew germplasm have been conserved and are being maintained in different centres (Table 1.1).

During the year 1995-96, a total of 25 collections were identified/collected by different centres (Table 1.1) and thus the total

Table 1.1. Cashew germplasm holding in different centres.

Centre	No. of accessions existing	No. of accessions collected/identified during 1995-96	Total
East Coast Region			
Bapatla	116	—	116
Bhubaneswar	84	3	87
Jhargram	127	2	129
Vridhachalam	255	—	255
West Coast Region			
Madakkathara	120	2	122
Pilicode	15	18	33
Vengurla	161	—	161
Maidan Region			
Chintamani	116	—	116
	994	25	1019

collections in the different centres increased to 1019.

The details such as source of collection, number of collections, salient features of collections are presented in Table 1.2. These include four cluster bearing types and seven bold nut types.

2. Germplasm evaluation

Evaluation of cashew germplasm material at different centres has been carried out during the year 1995-96 and some of the promising accessions in different centres are presented in Tables 1.3 to 1.8.

At Bapatla, of the seedling accessions which were planted during 1942-62, six accessions were found to be promising

(Table 1.3). In the 30-40 year old trees the nut yield ranged from 32.0 - 90.6 kg/plant, nut weight ranged from 5.0 - 6.4g and shelling percentage from 26.0 - 29.0.

At Bhubaneswar, of the 34 accessions which were planted during 1990-91, 11 accessions gave an yield of more than one kg/plant during 1995-96 (Table 1.4). Eleven cashew varieties collected from different centres were also found to be promising (Table 1.4). The highest yield (2.5 kg/plant) was recorded in the variety Bhubaneswar-1, followed by BPP-4 (2.0 kg/plant) (Table 1.4).

At Jhargram, of the accessions which were planted during 1983-85, seven accessions were found to be promising (Table 1.5). In the 10-12 year old plants the nut yield

Table 1.2. Cashew germplasm identified/collected by different centres during 1995-96.

Centre	Source of collection	No. of collections	Remarks
Bhubaneswar	Pitapalli and Chatrapur	3	Cluster bearing types (2 No.) Boldnut type (1 No.)
Jhargram	Deepal and Hameerpur	2	Cluster bearing types Minimum infestation of TMB and Thrips.
Madakkathara	Malavi and Brazil	2	—
Pilicode	Balal/ Mandapam/ Pilicode	18	Bold nut types (7 No.) Diverse type (11 No.)
Total		25	

Table 1.3. Evaluation of cashew germplasm at Bapatla centre during 1995-96

Accessions	Year of planing	Cumulative yield/Plant (kg) (1983-1995)	Yield/plant (kg) (1995-96)	Nut Weight (g)	Shelling percentage
T.71	1942	491.2	59.9	5.2	27.0
228	1942	358.9	90.6	5.2	28.0
2/3	1962	213.1	32.0	6.4	27.0
6/20	1962	252.8	47.1	5.0	26.0
10/4	1962	356.3	40.8	5.2	29.0
233(L)	1962	244.5	44.1	5.0	29.0

Table 1.4. Evaluation of cashew germplasm at Bhubaneswar centre during 1995-96.

Accession No.	Year of planting	Yield/plant(kg) (1995-96)	Nut Weight (g)
OC-1	1990	2.3	
OC-3	1990	1.3	
OC-7	1990	1.1	
OC-24	1990	2.4	
OC-25	1990	1.4	
OC-29	1990	1.1	
OC-31	1990	1.3	
OC-33	1990	1.4	
OC-43	1990	1.1	
OC-44	1990	2.2	
OC-50	1990	1.1	

Cashew varieties

BPP-4	2.0	5.0
BPP-5	1.3	4.8
BPP-6	1.3	5.2
VRI-2	1.3	5.0
NRCC Sel. 1	1.6	7.2
NRCC Sel.. 2	0.9	8.2
Ullal-1	1.0	6.5
Ullal-2	1.7	5.5
Anakkayam-1	1.2	5.6
Madakkathara-1	1.9	6.5
Bhubaneswar-1	2.5	4.6

ranged from 9.5 - 18.0 kg/plant, nut weight from 4.6 - 6.5g and shelling percentage from 28.8 - 33.2 (Table 1.5).

At Vridhachalam, of the 130 accessions which were planted during 1989, nine accessions were found to be promising (Table 1.6). In the six year old plants the nut yield was more than a kg, nut weight ranged from 5.0 - 7.5 g and shelling percent-

age ranged from 26.7 - 29.8 (Table 1.6).

At Vengurla, of the 81 accessions evaluated, seven accessions were found to be promising (Table 1.7). In the 15-17 year old plants, the nut yield ranged from 4.7 - 11.4 kg/plant, nut weight from 5.1 - 7.1g and shelling percentage from 21.0 - 30.7 (Table 1.7).

Table 1.5. Evaluation of cashew germplasm at Jhargram centre during 1995-96.

Accession No.	Year of planting	Cumulative Yield/plant (kg)	Yield/plant (kg) (1995-96)	Nut weight (g)	Shelling %
JGM 16/1	1983	42.0*	11.2	5.3	33.2
JGM 17/1	1983	48.1*	14.6	6.0	31.2
JGM 71/5	1983	72.6*	7.6	5.1	28.8
JGM 74/6	1983	43.4*	18.0	6.5	29.1
JGM 19/1	1984	44.0**	9.5	4.9	30.5
JGM 80/2	1984	44.5**	13.9	4.6	33.0
JGM 48/4	1985	37.6***	9.9	5.0	32.7

* Cumulative yield of 8 years ; ** Cumulative yield of 7 years ; *** Cumulative yield of 6 years

Table 1.6. Evaluation of cashew germplasm at at Vridhachalam centre during 1995-96

Accession No.	Year of planting	Cumulative Yield/plant (3 annual harvests) (kg)	Yield/plant (kg) (1995-96)	Nut weight (g)	Shelling %
M-10/4	1989	2.2	1.1	6.4	27.4
M-26/1	1989	2.0	1.3	6.4	28.4
M-26/2	1989	2.4	1.1	7.2	28.2
M-26/4	1989	3.7	1.2	6.5	28.4
M-33/3	1989	4.3	2.0	7.4	27.2
M-44/3	1989	3.3	1.1	6.2	27.5
M-88/4	1989	2.0	1.3	6.6	29.8
NR-51	1989	2.3	1.8	7.8	26.7
Nr-61	1989	2.3	1.8	5.0	28.6

Table 1.7. Evaluation of Cashew germplasm at Vengurla centre during 1995-96.

Accession No.	Year of planting	Cumulative Yield/plant (kg)	Yield/plant (kg) (1995-96)	Nut weight (g)	Shelling %
80/2/4(M6-1)	1977	58.0	6.4	5.1	27.2
83/5/3(Tree No.1 BPP)	1977	63.8	4.7	6.0	27.6
89/12/3(BLA 256)	1977	73.8	5.1	5.3	30.7
94/17/5(ST 94)	1977	79.6	6.1	7.1	23.0
98/12/4	1977	72.9	6.3	6.3	21.0
124/15/3	1979	54.4	5.9	6.8	29.5
126/17/2	1980	61.9	11.4	6.0	28.4

At Chintamani, of the 72 accessions evaluated, four accessions were found to be promising (Table 1.8). In the 10-12 year old

plants the nut yield ranged from 10.3-31.2 kg/plant, nut weight from 5.4 - 6.5g and shelling percentage from 26.8-31.9 (Table 1.8).

Table 1.8. Evaluation of Cashew germplasm at Chintamani centre during 1995-96.

Accession No.	Year of planting	Cumulative yield/Plant (kg)	Yield/plant (kg) (1995-96)	Nut weight (g)	Shelling %
29/1 ARSC (13/5 Kodur)	1983	61.9*	17.8	5.4	26.8
35/1 ARSC (ME 4/4)	1983	56.8*	10.3	6.5	31.9
38/3 ARSC (Hyb.2/15)	1984	44.6**	15.3	6.1	30.0
41/3 (ARSC) 5/37 MANJE-RI)	1985	78.3***	31.2	5.7	30.4

* Cumulative yield of 10 years. ; ** Cumulative yield of 9 years. ; *** Cumulative yield of 8 years.

Project title : Gen. 3 : Varietal evaluation

Three varietal trials are under evaluation at different centres.

Expt. 1 : Comparative yield trial in cashew

Centre : Chintamani

Objective :

To evaluate the performance of varieties of Bapatla and Vengurla.

Bapatla entries: Bapatla-1, Bapatla-3, Bapatla-4, Bapatla-5, Bapatla-6.

Vengurla entries: Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5

Year of planting: 1986

The performance of the varieties is given in Table 1.9.

Nut yield:

Significant differences were observed among varieties for nut yield. The highest nut yield of 13.0 kg/tree was recorded in Vengurla-5 which was followed by Vengurla-3 (10.5 kg/tree) and Bapatla 6 (10.5 kg/tree) in sixth harvest. In Vengurla-4 the lowest nut yield of 6.2 kg/tree was recorded. The cumulative yield ranged from 16.6 kg/tree (in Vengurla 4) to 36.9 kg/tree (in Vengurla-5) for the 6 years period. Cumulative yield of 32.9 kg/tree in Bapatla-6, 29.4kg/tree in Vengurla-3 and 29.2 kg/tree in Vengurla-2 in 6 years were recorded.

Nut weight :

The varieties exhibited range of 4.1g to 7.0 g. for nut weight. Differences among varieties for nut weight was significant. Vengurla-3 had highest nut weight (7.0g) and Vengurla 5 had the least (4.1g).

No. of fruits/panicle :

Highest number of fruits per panicle (8.1) was recorded in Vengurla-5 which varied significantly from the remaining nine varieties.

Although the variety Vengurla-5 had highest annual nut yield (13.0 kg/tree) in 6th harvest and highest cumulative yield (36.9 kg/tree) and highest number of fruits/panicle (8.1), the nut weight was very low (4.1g). Bapatla-6 had second highest cumulative yield (32.9 kg/tree) with nut weight of 5.9 g. Performance of Vengurla-3 for annual yield (10.5 kg/tree), cumulative yield (29.4 kg/tree) and nut weight (7.0g - highest) was quite encouraging. However, both the varieties (Bapatla 6 and Vengurla 3) have low shelling percentage. In overall assessment, Vengurla-1 and Bapatla 5 varieties appear to be suitable to maidan area/Chintamani area based on this trial.

Table 1.3. Performance of different varieties for yield, yield parameters and growth characteristics at Chintamani centre in comparative yield trial during 1995-96.

I. No.	Variety	Nut yield (kg/tree) (6th harvest)	Cumulative Nut yield (kg/tree)	Nut weight (g)	No. of fruits/ panicles	Flowering period	Height (m)	Stem girth (cm)	Canopy shape
1	Vengurla-1	9.7	24.4	5.4	4.8	Medium	5.6	72.1	Compact
2	Vengurla-2	9.2	29.2	4.2	4.8	Long	5.9	69.4	Medium
3	Vengurla-3	10.5	29.4	7.0	5.6	Medium	6.2	78.1	Sparse
4	Vengurla-4	6.2	16.6	6.0	3.9	Medium	5.3	62.5	Sparse
5	Vengurla-5	13.0	36.9	4.1	8.1	Medium	5.6	69.5	Compact
6	Bapatla-1	6.4	18.2	4.3	3.6	Medium	5.6	64.1	Compact
7	Bapatla-3	6.6	21.6	4.6	3.6	Medium	5.7	72.9	Medium
8	Bapatla-4	7.7	24.2	5.1	4.7	Long	6.0	75.1	Medium
9	Bapatla-5	7.8	25.6	5.0	5.5	Medium	5.6	66.4	Compact
10	Bapatla-6	10.5	32.9	5.9	4.7	—	5.8	77.7	Compact
	SEm (\pm)	1.31		0.32	0.60		0.18	3.25	
	CD (P=0.05)	3.89		0.95	1.78		NS	9.67	
	CV (%)	25.85		7.55	21.12		6.70	7.96	

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

Centres:

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

Objectives:

To evaluate the high yielding varieties in different locations.

Varieties : No. of entries: 16+3

Bapatla entries: T.No.129, T.No.40, H 2/15, H 2/16

Vengurla entries: V-2, V-3, V-4, V-5(H 24), M 44/3

Vridhachalam entries: M 33/3, M 44/3, M 26/2

Vittal entries: VTH 30/4, VTH 59/2, M 44/3 (VTH 12)

Madakkathara entries: H 1598(Kanaka), H 1600, H 1608 (Dhana), H 1610.

Note: Ullal-1 and Ullal-2 varieties were planted in place of M 26/2 and M 33/3 at Chintamani centre in 1992 as they could not be established.

Year of planting: 1986

This trial was conducted in six centres to study the performance of high yielding varieties at six locations for yield, yield component characters (no. of fruits or nuts/panicle, nut weight).

Nut yield :

Nut yield (1995-96) of the different varieties at six centres and cumulative yield of the varieties at three centres are presented in Table 1.10.

Highest annual yield and highest cumulative yield was recorded by M 44/3 of Vridhachalam source at Chintamani centre (11.1 kg/tree and 33.6 kg/tree respectively) as well as at Vridhachalam centre (11.9 kg/tree and 15.9 kg/tree, respectively) among varieties tested at respective centre.

Higher annual as well as higher cumulative yield were registered by Vridhachalam entries over the other entries at Vridhachalam. Vengurla-5 (H-24) exhibited highest annual yield in Madakkathara centre (13.9 kg/tree) and in Vengurla centre (6.2 kg/tree). In Jhargram centre, VTH 59/2 ranked first with yield of 7.7 kg/tree while in Bhubaneswar centre, H2/16 stood first with yield of 15.7 kg/tree.

In overall mean yield (based on the performance over 6 locations), M 44/3 of Vridhachalam source ranked first (7.1 kg/tree) among the varieties tested.

Cumulative yield figures were available for 3 centres (Chintamani, Madakkathara and Vridhachalam). In Madakkathara centre, highest cumulative yield (44.7 kg/tree) was recorded in M 26/2, followed by M 44/3 with yield of 44.4 kg/tree. In the overall mean cumulative yield, M 44/3 ranked first (31.3 kg/tree).

The varieties identified/selected based

Table 1.10 . Performance of different varieties for yield/plant and cumulative yield/plant in Multilocation Trial-86 (MLT-86) in different centres during 1995-96.

Sl. No.	Varieties	Yield/plant (kg/tree)				Cumulative yield (kg/tree)						
		Bhubaneswar	Chintamani	Jhargram	Madakathara (5th har.)	Vengurla	Vridhachalam	Mean	Chintamani (6th har.)	Madakathara	Vridhachalam	Mean
1.	Vengurla-2	4.2	4.0	—	5.3	6.0	3.0	4.5	16.0	20.9	9.4	15.4
2.	Vengurla-3	4.4	7.8	—	7.1	4.5	0.4	4.8	21.1	32.0	1.2	18.1
3.	Vengurla-4	5.0	6.3	—	6.9	4.5	0.7	4.7	20.0	30.2	4.5	18.2
4.	Vengurla-5(H-24)	—	6.7	—	13.9	6.2	0.8	6.9	23.3	39.6	11.4	24.8
5.	T.No.40	4.5	2.7	4.8	4.7	2.7	5.3	4.1	17.8	18.5	8.7	15.0
6.	T.No.129	2.5	6.2	4.3	3.5	4.1	4.5	4.2	19.8	15.1	5.9	13.6
7.	H-2/15	3.4	6.8	5.6	8.0	4.6	0.9	4.9	20.3	25.1	4.6	16.7
8.	H 2/16	15.7	6.2	5.8	4.8	4.1	4.7	6.9	19.2	20.7	6.8	15.6
9.	H 1598	7.1	8.5	4.4	11.0	5.9	2.2	6.5	22.2	43.2	5.3	23.6
10.	H 1600	3.5	5.5	3.5	6.8	4.8	0.8	4.2	23.8	33.9	2.1	19.9
11.	H 1608	8.7	10.3	3.4	7.8	5.4	2.9	6.4	28.1	34.7	6.1	23.0
12.	H 1610	4.0	8.2	3.9	2.2	4.5	NA	4.6	23.6	17.8	1.9	14.4
13.	VTH 30/4	4.0	4.9	5.9	9.7	3.4	3.5	5.2	15.8	32.5	8.6	19.0
14.	VTH 59/2	4.6	7.9	7.7	5.6	3.7	0.7	5.0	22.9	25.4	7.2	18.5
15.	M 26/2	5.0	—	3.5	10.2	—	8.8	6.9	—	44.7	14.4	29.6
16.	M 33/3	—	—	5.2	5.4	—	8.0	6.2	—	29.4	13.3	21.4
17.	Annakkayam*	—	—	—	9.6	—	—	—	—	36.3	—	—
18.	M 44/3(VTH 12)*	3.7	7.7	—	—	—	—	—	20.7	—	—	—
19.	M 44/3(VRI)	3.3	11.1	3.4	10.2	2.6	11.9	7.1	33.6	44.4	15.9	31.3
20.	M 44/3(Vengurla)*	—	5.4	—	—	—	—	—	14.1	—	—	—
	CD 5%	2.24	3.44	0.67	3.21	1.29	1.63					
	CV %		29.99									

* Not considered for interpretation

on their yield performance in MLT-86 trial during 1995-96 in different centres located

in the different agroclimatic zones are as under:

Sl. No.	Region	Variety	Based on performance at centres
1.	East coast	H 2/16	Bhubaneswar Jhargram
2.	West Coast	Vengurla-5 (H-24)	Madakathara Vengurla
3.	Low rainfall area (Maidan area)	M 44/3 H 1608	Chintamani
4.	Medium to high rainfall area	VTH 59/2 VTH 30/4 H 2/16 H 2/15	Jhargram
5.	Very high rainfall area	Vengurla 5 (H 24) H 1598	Madakkathara Vengurla

In Jhargram centre, H 2/16 gave the cumulative yield of 24.0 kg/tree as against 14.1 kg/tree cumulative yield of M 26/2 over a period of 5 years.

Nut weight :

Nut weight of the entries of Multi location Trial-86 (MLT-86) were reported by four centres and the same is given in Table 1.11.

At Bhubaneswar and Chintamani centres H 1610 exhibited highest nut weight of 8.3g and 7.3g, respectively. At Madakkathara centre H 1600 showed highest nut weight of 10.1g while at Vridhachalam

centre H2/16 had the boldest nut (nut weight of 9.5g).

Number of nuts per panicle :

Number of nuts per panicle was reported by three centres, namely, Bhubaneswar, Chintamani and Vridhachalam and the same is presented in Table 1.12.

Highest number of nuts per panicle was recorded in M 26/2 variety at Bhubaneswar (6.3) and Vridhachalam (13.4) while M 44/3 showed the highest number at Chintamani (6.7).

Table 1.11. Performance of different varieties for nut weight (g) in Multilocation trial-86 (MLT-86) in different centres during 1995-96.

Sl. No.	Varieties	Bhubaneswar	Chintamani	Madakkathara	Vridhachalam
1.	Vengurla-2	4.3	3.8	5.4	6.5
2.	Vengurla-3	7.7	6.7	7.8	7.9
3.	Vengurla-4	7.0	6.5	8.7	8.3
4.	Vengurla-5(H 24)	-	3.6	3.5	5.5
5.	T.No.40	4.3	4.3	5.4	6.2
6.	T.No.129	4.4	4.8	5.7	6.5
7.	H 2/15	8.2	6.6	7.5	9.4
8.	H 2/16	7.5	7.1	9.4	9.5
9.	H 1598	5.4	5.1	5.9	7.0
10.	H 1600	6.2	6.1	10.1	5.8
11.	H 1608	7.8	6.3	7.8	6.8
12.	H 1610	8.3	7.3	8.3	Not available
13.	VTH 30/4	7.7	5.2	5.7	7.8
14.	VTH 59/2	5.6	5.1	8.1	8.7
15.	M 26/2	4.7	-	7.5	7.4
16.	M 33/3	-	-	7.6	8.0
17.	Anakkayam	-	-	5.4	-
18.	M 44/3(VTH 12)	4.5	4.7	-	-
19.	M 44/3(VRI)	4.7	3.6	5.2	-
20.	M 44/3(Vengurla)	-	3.9	-	-
	CD 5%	-	0.78	-	0.31
	CV(%)	-	8.64	-	

Table 1.12. Performance of different varieties for number of nuts per panicle in Multilocation Trial-86 in different centres during 1995-96.

Sl. No.	Varieties	Bhubaneswar	.Chintamani	Vridhachalam
1.	Vengurla-2	6.0	2.8	10.4
2.	Vengurla-3	6.0	3.6	5.6
3.	Vengurla-4	4.8	4.1	8.4
4.	Vengurla-5(H 24)	-	5.0	9.2
5.	T.No.40	4.6	2.5	9.2
6.	T.No.129	4.3	3.2	6.6
7.	H 2/15	2.2	3.0	8.6
8.	H 2/16	6.2	2.6	11.2
9.	H 1598	5.6	2.7	7.2
10.	H 1600	5.2	2.6	6.4
11.	H 1608	4.3	3.6	8.8
12.	H 1610	5.5	4.4	-
13.	VTH 30/4	2.0	2.6	10.2
14.	VTH 59/2	4.7	3.1	7.2
15.	M 26/2	6.3	-	13.4
16.	M 33/3	-	-	10.2
17.	Anakkayam	-	-	-
18.	M 44/3(VTH 12)	3.5	3.9	-
19.	M 44/3(VRI)	4.5	6.7	15.4
20.	M 44/3(Vengurla)	-	2.8	-
	CD 5%		1.65	
	CV (%)		28.30	

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

Centres

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

Objectives:

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

Varieties:

No. of entries: 13

Bapatla entries: Hy 3/28, 3/33, 10/19, 30/1

Vengurla entries: H 68, H 255, H 303, H 320, H 367

Vridhachalam entries: M 15/4, M 44/3

NRCC, Puttur entries: VTH 107/3, VTH 40/1

Year of planting: 1992

This trial was taken up in 1992 at six centres. In Jagdalpur centre, all the entries could not be planted and mortality in the those entries which were planted was also high. Replanting of the full trial in next year is planned. In Vengurla centre, the trial could not be planted due to non-availability of land and now it has been decided to take the trial at Cattle Breeding Farm, Nileli from next year.

As the trials are in the initial stage of plantation during the year under report and hence conclusion on the performance of the different varieties cannot be made.

Yield data and nut weight information

from Bhubaneswar and Chintamani centres are only reported (Table 1.13). However, information on growth parameters such as plant height and stem girth were recorded by all the six centres.

The highest yield at Bhubaneswar centre was registered in H-320 variety in the first harvest (1.9 kg/tree) while highest yield (1.2 kg/tree) at Chintamani centre was recorded in M 44/3 among the 13 varieties under evaluation. H 255 had the boldest nut size at both centres (Bhubaneswar 9.5g and Chintamani 7.7 g). Plant height and stem girth of all the entries were low at Vridhachalam centre. In Bhubaneswar centre maximum plant height (3.2 m), and maximum stem girth (34.9 cm) were recorded in H 255. In Chintamani centre, highest plant height (3.2 m) and maximum stem girth (40.0 cm) were recorded in VTH 107/3 (NRCC Sel.1). In Bhubaneswar and Chintamani centres, in M 44/3 least plant height (1.9 m and 2.0 m, respectively) was recorded while in variety M 44/3 maximum plant height (2.3 m) was recorded at Jhargram centre. In Madakkathara centre, highest plant height (3.3 m) was recorded in H 303. H 255 had least plant canopy spread in Bapatla centre (2.3 m) while it had maximum plant canopy spread in Bhubaneswar centre (4.3 m).

Table 1.13. Performance of different varieties for nut yield/tree and nut weight in Bhubaneswar and Chintamani centres under Multilocation Trial-92 (MLT-92) during 1995-96.

Sl. No.	Varieties	Yield/Tree(kg/tree)		Nut weight(g)	
		Bhubaneswar	Chintamani	Bhubaneswar	Chintamani
1	Hy 3/28	0.7	0.1	6.5	6.5
2	3/33	1.3	0.5	6.5	4.6
3	10/19	1.1	0.3	5.2	4.2
4	30/1	1.2	0.5	6.0	5.5
5	H 68	1.7	0.8	7.5	6.4
6	H 255	1.2	0.2	9.5	7.7
7	H 303	1.6	0.9	6.8	6.6
8	H 320	1.9	0.5	7.8	6.5
9	H 367	0.7	0.3	9.2	6.2
10	VTH 107/3 (NRCC Sel.1)	0.7	0.2	6.6	6.1
11	VTH 40/1 (NRCC Sel.2)	0.9	1.2	8.2	6.6
12	M 15/4	0.6	0.3	6.0	4.3
13	M 44/3	0.9	1.2	4.8	4.5
14	Ullal-1	-	0.3		6.0
	CD 5%	0.50	0.50		0.88
	CV(%)		54.31		8.80

Project Title : Gen. 4 : Hybridization and selection

Centres

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

Objectives:

The main objective of hybridisation and selection programme at various co-ordinating centres is to utilize the high yielding germplasm material in crossing with other varieties having desirable traits such as bold nuts, cluster bearing habit, compact canopy, short duration of flowering and high shelling percentage.

The details of hybridization programme carried out at various centres and performance of promising hybrids are as follows.

Bapatla

The existing hybrid plants (planted during 1980-81) were evaluated for their performance. The maximum yield of 19.0 kg

was observed in H4/1 followed by H3/10 in which the yield was 16.6 kg. The cumulative yield (1984-95), however, continued to be highest in H3/13 (135.4 kg) (Table 1.14). The crossing work done during the year did not yield any results as no fruit set has been observed.

Bhubaneswar

During the year hybridisation with BBSR X H 2/16, BBSR-1 x H 2/15, BBSR-1 x VTH 711/4 and BBSR-cluster x VTH 711/4 was done and an average success of 8.2 per cent was observed.

Chintamani

The 3/108 Gubbi x Vetore-56 cross combinations was attempted. In this 18 hybrid seedlings survived in the fields.

Jhargram

Clonal materials of boldnut types (Vetore-56 and Kankadi from Vengurla and VTH-711/4 Brazilian type from NRCC, Puttur) were collected and planted during 1992 for hybridisation programme.

Madakkathara

A total of 176 hybrid seedlings available from crosses done since 1993 to 1995 are

available for evaluation in the field. Growth characters (height, girth and canopy spread) and yield of these seedlings were being recorded.

Vengurla

During the period crossing work with eight different combinations was carried out and a total of 240 hybrid seedlings were obtained. A total of 1840-F1 hybrids planted between 1983-1994 are under evaluation (Table 1.15). The best performing hybrid was H255 (V-3 x M 10/4) which gave highest yield of 18.5 kg followed by H 445 which gave 12.9 kg during current harvesting season. The hybrid 255, 303, 320 and 367 have been included in the multilocational trial 92.

Vridhachalam

Performance of eight promising hybrid progenies derived from the cross-combination of M 10/4, M 44/3, M 26/2, M 26/1, M 45/4 and M 95/3 has been assessed. During the year 1995 the highest yield 1.5 kg/tree was recorded in H-16 followed by H-17 in which yield was 1.4 kg/tree. In general, the hybrid H-13 was superior when the mean yield data for last 6 years was taken into consideration (Table 1.16).

Table 1.14. Performance of hybrids at Bapatla centre.

Sl. No.	Hybrid	Parentage	Yield in 1995 (Kgs)	Cumulative yield (1984-95)	Apple weight (g)	Nut weight (g)	Shelling percentage
1	2/3	39 x 129	11.0	128.3	50.0	6.0	30.0
2	2/15	1 x 40	15.2	112.0	60.0	5.5	30.0
3	3/10	56 x 40	16.6	100.0	30.0	7.0	27.0
4	3/13	56 x 40	14.2	135.4	25.0	5.0	30.0
5	3/25	56 x M 104	6.4	104.8	45.0	5.5	33.0
6	4/1	1 x 100	19.0	105.0	51.0	5.0	30.0

Table 1.15. Performance of hybrids at Vengurla centre.

Sl. No.	Hybrid No.	Cross Combination	Mean yield for last 10 years	Highest yield obtained and year of orchard life	Yield (kg) of reporting year 1996	Nut wt. (g)	Shelling %
1.	248	Vengurla-3 x M 44/3	5.9	10.4	8.8	6.2	28.0
2.	255	Vengurla-3 x M-10/4	10.7	33.4	18.5	8.0	30.5
3.	303	Vengurla-4 x M 10/4	6.8	12.7	3.4	8.9	27.0
4.	320	M 44-3 x Vetore-56	7.3	14.8	4.7	7.5	31.6
5.	367	Vengurla-4 x M 10/4	10.5	22.5	10.0	8.3	28.0
6.	444	M 10/4 x Vetore-56	5.5	9.3	6.5	7.5	28.5
7.	445	M 10/4 x Vetore-56	6.3	12.9	12.9	7.5	28.5
8.	454	M 10/4 x Vetore-56	7.2	11.8	10.9	8.0	28.0
9.	453	M 10/4 x Vetore-56	5.1	8.2	8.0	8.2	28.0
10.	509	Vengurla-4 x M 44/3	6.4	9.3	6.3	6.0	29.0
11.	304	Vengurla-4 x M 10/4	6.3	8.3	6.8	6.8	29.0

Table 1.16. Performance of hybrids at Vrindhachalam centre.

Hybrid No.	Cross combination	Age of tree	Mean yield for 6 years (kg/tree)	Highest yield per tree (kg)	Yield of 1995	Apple weight	Nut weight	Shelling percentage	TMB damage score
H-10	M 10/4 x M 26/1	8 yrs.	2.9	3.6	0.7	69.7	7.5	30.4	4.0
H-11	M 10/4 x M 45/4	8 yrs.	2.4	2.9	0.6	58.8	6.5	30.0	3.2
H-12	M 10/4 x M 75/3	8 yrs.	1.9	2.5	0.6	64.9	7.3	32.9	3.8
H-13	M 26/2 x M 26/1	8 yrs.	3.6	4.5	0.4	55.5	6.3	27.4	3.8
H-14	M 26/2 x M 45/4	8 yrs.	2.7	3.2	0.8	51.4	4.7	26.9	3.6
H-15	M 26/2 x M 75/3	8 yrs.	1.9	2.8	0.6	47.3	4.6	28.7	3.2
H-16	M 44/3 x M 26/1	8 yrs.	2.7	5.0	1.5	55.2	6.9	32.3	3.8
H-17	M 44/3 x M 45/4	8 yrs.	2.0	2.6	1.4	51.6	6.6	28.3	3.4

A. AGRONOMY

Project Title : Agr. 1 : NPK fertilizer experiment.

Centres:

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

Objective :

The main objective of this experiment is to study response of vegetatively propagated material of cashew to different doses of NPK fertilizers.

Significant difference in height and spread were observed between trees receiving no phosphorus and trees receiving 125 and 250g P_2O_5 /tree (Table 2.1).

Design :

Three factorial confounded design with 27 treatment combinations.

Replication: Two

In an observational trial it was noticed that there was increase in girth, canopy spread, and number of flowering panicles/Sq.m and yield/tree in the case of plants receiving highest dose of fertilizer (1500 g N, 375g P_2O_5 and 375 g K_2O /plant) as compared to trees receiving the lowest dose of fertilizers (500g N, 125g P_2O_5 and 125g K_2O /tree) (Table 2.2)

Treatments :

N : 0, 500 and 1000g/plant
 P_2O_5 : 0, 125 and 250g/plant
 K_2O : 0, 125 and 250g/plant

East Coast :

Bapatla

The stem girth of the plant increased significantly with the N application from 0 to 500gN/tree whereas it remained at par when tree received 500 g N and 1000 g N. Phosphorous and potassium did not affect girth of the stem. Significant differences in height and spread were observed between trees receiving no nitrogen (141.5cm and 175.7cm respectively) and trees receiving 500g N (184.7cm and 282.3cm respectively) and 1000g N (181.0cm and 267.9cm respectively).

Bhubaneswar

The plant height increased significantly with application of nitrogen and phosphorus as compared to control. The plant height was found to be directly correlated to NPK levels. Maximum height was recorded (322 cm) in N_2 (1000 g N/plant) followed by N_1 (500gN/plant) and minimum was recorded in control N_0 (236 cm). Similarly, application of phosphorus at 250g/plant (P_2) significantly increased height over P_1 and P_0 levels (125 g P_2O_5 & 0g P_2O_5 /tree). The interaction effect of NPK was not observed. Linear response to Nitrogen and phosphorus was

Table 2.2. Effect of recommended and alternate NPK doses on growth characteristics, flowering and yield at Bapatla centre.

Treatments	Girth (cm)	Canopy (m)	No. of flowering panicles/sq.m.	Yield/tree (kg)
T1	116.3	9.0	13.2	8.5
T2	131.5	9.2	16.0	11.2
T3	123.4	9.6	17.5	11.8

Note: T1 - N = 500, P = 125, K = 125
 T2 - N = 1000, P = 250, K = 250
 T3 - N = 1500, P = 375, K = 375

Vengurla

At Vengurla, the experiment was laid out in 1990. Though no significant difference was observed, maximum height, girth and spread (203 cm, 21 cm and 159 cm, respectively) was recorded in the combination $N_2P_1K_1$ (1000g N, 125g each of P_2O_5 and K_2O).

Maidan Region Chintamani

The experiment was laid out in 1987 at Chintamani located in Maidan Region. The grafts of the variety Ullal-1 were used in this experiment and planted at a spacing of 7.5m x 7.5m. Data on plant height, stem girth and canopy spread during 1995-96 and nut yield per tree recorded during 1995 are presented in Table 2.3.

Stem girth did not differ significantly to different levels of N & K and interaction of different levels of N, P_2O_5 and K_2O . However, stem girth differed significantly to different levels of phosphorus. The stem girth increased as the level of P increased (Table 2.3).

No significant differences were observed either due to different levels of N,P,K or their interactions on East-West tree canopy spread, but, with respect to North-South canopy significant differences were observed only with respect to P. The tree spread increased as the level of P increased.

Significant differences were not observed either due to N and P and interactions of N, P_2O_5 and K_2O . However, significant influences were observed with respect to K. Total number of shoots/m² increased as the level of K increased. Significant differences were observed in number of inflorescence/m² only with respect to P. Number of inflorescence/m² decreased as the level of P increased.

The nut yield did not vary significantly due to main effects of NPK. However, application of N at 1000g/tree recorded maximum nut yield of 6.4 kg/tree compared to 4.9 kg/tree with no application of N. Similarly, higher levels of P and K i.e., application of 250g/tree recorded maximum nut yield of 6.1 kg and 6.5 kg respectively compared to

Table 2.3. Effect of different levels of NPK and their interactions on growth and yield at Chintamani centre.

Treatments	Girth (cm)	Height (cm)	Spread (cm)		No. of shoots/ m ²	No. of Inflorescence/ m ²	Nut yield kg/tree	100 Nut wt (g)
			NS	EW				
N0	67.7	546	7.7	7.9	25.7	16.2	4.9	649
N 500	66.2	546	7.7	7.5	28.9	17.5	5.4	638
N 1000	67.6	554	8.1	7.9	27.0	18.0	6.4	631
P0	64.5	532	7.4	7.6	27.7	19.0	5.1	646
P 125	67.6	558	8.1	8.0	25.4	17.6	5.6	636
P 250	69.4	556	8.0	7.9	25.5	15.2	6.1	636
K0	67.8	556	8.1	8.1	24.9	16.8	5.5	654
K 125	68.6	552	7.8	7.9	25.4	17.0	4.7	643
K 250	65.0	538	7.6	7.6	28.3	17.9	6.5	621
SEm for NPK	1.1	0.09	0.2	0.1	0.8	1.0	0.7	10
SEm for NP/NK/PK	1.9	0.23	0.8	0.2	1.4	1.7	0.8	17
CD for NPK	3.16(P)	NS	0.44(P)	NS	2.42(K)	2.90(P)	NS	NS
CD for NP/NK/PK	NS	NS	NS	NS	NS	NS	2.47(NK)	NS

5.1 and 5.5 kg with no application of P and K (Table 2.3).

Among interactions only PK recorded significant difference. Application of 250 g each of P and K recorded highest nut yield of 8.6 kg/tree compared to 4.1 kg by the trees receiving lowest phosphorus (P_0) and 250 g potassium (K_2) which was the lowest among the PK interactions. (Table 2.4).

Table 2.4. Interaction effect of PK on the nut yield (kg/tree) at Chintamani centre.

Treatment	Yield(Kg/tree)
P_0K_0	6.1
P_0K_1	5.1
P_0K_2	4.1
P_1K_0	5.6
P_1K_1	4.3
P_1K_2	6.9
P_2K_0	4.9
P_2K_1	4.9
P_2K_2	8.6
CD for PK (0.05)	2.47

Project Title : Agr. 4 : Spacing trial in cashew

Centres:

East Coast : Jhargram
West Coast : Vengurla

Objective :

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

East Coast Jhargram

The experiment details and treatments for the trial laid out are as under :

Experimental details :

Design : RBD
Replication : 3
Plot size : 25m x 25m
Area covered : 2.25 ha
Variety : Red Hazari
Year of planting : July, 1982
(Seedling)

Spacing :

- 5m x 5m : Square with no thinning
- 5m x 5m : Square with thinning of 50% plants

- 5m x 5m : Square with thinning of 75% plant (after 6 years in 1990)
- 10m x 5m : Rectangular (after 11 years)
- 10m x 5m : Rectangular with thinning of 50% plants (after 6 years, done in 1990)
- 10m x 10m : Square
- 10m x 10m x 10m : Triangular
- 8m x 8m : Square
- 8m x 8m x 8m : Triangular
- 6m x 6m : Square
- 6m x 6m x 6m : Triangular
- 5m x 5m : Square with selective thinning of 50- 75% plants. During 1990, 50% plants were removed selectively.

Significant variations in respect of number of nuts per tree, yield per tree and yield per block among different treatments (Table 2.5). Maximum number of nuts/tree (1046) and nut yield/tree (4.6 kg) were observed in trees spaced at 10m x 5m rectangular system with no thinning followed by 8m x 8m square system (927, 4.3 kg respectively). The minimum number of nuts/tree (532) and yield/tree (2.4 kg) were observed in 10m x 10m x 10m triangular system and 5m x 5m square with 75% thinning (533, 2.1 kg, respectively). With regard to yield/block the trees planted in 6m x 6m x 6m triangular system ranked first being 63.9 kg followed by 62.2 kg, 55.9 kg and 52.2 kg in 5m x 5m square system with no thinning, 6m x 6m square and 5m x 5m square system with 75% thinning respectively and the same was minimum (9.8 kg) under 10m x 10m square system. The maximum cumulative yield per block for last eight years (1988-1995) of 346.3 kg was observed in 5m x 5m square system with no thinning while the same was 331.9 kg, 297.3 kg and 291.3 kg under 6m x 6m x 6m triangular, 6m x 6m square and 5m x 5m square system with 75%

thinning, respectively. The trees planted under 10m x 10m square system recorded the minimum cumulative yield per block (54.8 kg).

West Coast

Vengurla

The experiment was laid out in July, 1990 and growth observations and yield were recorded and presented in Table 2.6. Significant differences in height and girth were observed due to different densities/unit area 5 years after planting. It was observed that the height and girth of the trees (1.8 m and 19 cm respectively) were significantly more in the case of treatment where trees were spread at 5m distance than in the case of trees spaced at 10m x 5m, 10m x 10m x 10m triangular and 8m x 8m x 8m triangular systems (height, 1.6, 1.3 and 1.4 m respectively and 16.1 and 13 cm girth respectively).

Yield was maximum in treatments T1, T2 and T3 where spacing adopted was 5m x 5m. Thinning of population was not done so far, as the experiment was laid out only in 1990.

Project Title : Agr. 6 : Cashew based cropping system

Centres :

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

Objectives :

Finding out suitable intercrop that can be grown in the initial years of cashew orchard.

Annual crops identified for different centres are as follows:

- Bapatla - Sesamum, Cowpea, groundnut, horsegram and greengram.
- Bhubaneswar - Sesamum, cucumber and other economically feasible annuals.

Experimental details

Design : RBD
 Replication : Three

Table 2.5. Effect of different spacing on yield of Cashew at Jhargram centre.

Sl. No.	Treatments	No. of plants/ block	Canopy	No. of nuts/ plant	Yield/plant (kg)	Yield/block (kg)	Cumulative yield/block (kg) 1988-95)
1.	5m x 5m square - no thinning	25	Medium	552	2.6	62.2	346.3
2.	5m x 5m square - 50% thinning	13	Medium	607	2.6	33.7	182.7
3.	5m x 5m square - 75% thinning	25	Medium	533	2.1	52.2	291.3
4.	10m x 5m rectangular	8	Medium	1046	4.6	36.5	189.5
5.	10m x 5m rectangular-50% thinning	4	Medium	784	3.4	13.6	84.4
6.	10m x 10m square	4	Medium	594	2.4	9.8	54.8
7.	10m x 10m x 10m triangular	7	Medium	532	2.4	16.9	95.3
8.	8m x 8m square	9	Medium	927	4.3	38.7	243.9
9.	8m x 8m x 8m triangular	12	Medium	816	3.4	41.1	210.4
10.	6m x 6m square	16	Medium	676	3.5	55.9	297.3
11.	6m x 6m x 6m triangular	22	Medium	632	2.9	63.4	331.9
12.	5m x 5m square -selective thinning	13	Medium	618	2.7	34.7	198.3
	S.Em (\pm)	—	—	49.56	0.21	4.08	
	C.D. at 5%	—	—	145.34	0.63	11.98	

Table 2.6. Effect of different spacings on growth and yield at Vengurla Centre (1995).

Sl. No.	Treatments	Average height (m)	Average girth (cm)	E-W	Spread (m)	N-S	Block Yield in kg/Block	(50 x 50m) Plants per Block
1.	T1 5m x 5m No thinning	1.8	19	1.5	1.6	1.6	19.6	100
2.	T2 5m x 5m-50% thinning	1.8	18	1.4	1.5	1.5	23.0	100
3.	T3 5m x 5m-75% thinning	1.8	18	1.5	1.6	1.6	21.8	100
4.	T4 10m x 5m No thinning	1.6	16	1.3	1.3	1.3	4.4	50
5.	T5 10m x 5m-50% thinning	1.8	17	1.3	1.4	1.4	4.8	50
6.	T6 10m x 10m No thinning	1.7	15	1.3	1.3	1.3	1.5	25
7.	T7 10m x 10m x 10m No thinning	1.3	12	1.3	1.1	1.1	0.9	28
8.	T8 8m x 8m No thinning	1.7	15	1.3	1.5	1.5	2.1	39
9.	T9 8m x 8m x 8m No thinning	1.4	13	1.0	1.0	1.0	5.6	45
S.Em (±)		0.08	0.03	0.10	0.08	0.08	—	—
C.D 5%		0.24	2.76	N.S.	0.24	0.24	—	—

Note : Thinning in T2, T3 and T5 not started.

- Madakkathara - Annuals suitable to the area, medicinal plants.
- Vridhachalam - Groundnut, blackgram, cowpea and red gram.

Spacing

- Main Crop - Cashew 8m x 8m
- Inter crops - Annuals - 10m x 5m - N/S direction

East coast

Bapatla

At Bapatla, greengram, blackgram, groundnut, cowpea & cluster bean were grown as intercrops in existing cashew plantation. Intercrops were grown in kharif season. Out of them, intercrops cowpea and cluster bean only gave marginal yields of 62.5 and 825 kg/ha (green pods) respectively.

Bhubaneswar

The experiment was laid out with main plot and subplot treatments at Bhubaneswar. Details of the treatments are as follows.

Spacing :

- Design - Split plot
- No. of Replications - 3
- No. of Main plots - 4
- No. of Sub-plots - 3

Main plot treatments :

1. Cashew alone (Main crop)
2. Cashew + Sesamum
3. Cashew + Horsegram
4. Cashew + Blackgram

Sub plot treatments :

1. No additional fertilizers to intercrop
2. Application of additional fertilizers to intercrops as per recommendation.

3. 50% of the recommended fertilizer doses to the inter-crops in addition to main crop.

The intercrops were raised in three years old cashew plantation. The yield realised from the intercrops are presented in Table 2.7.

West Coast

Vengurla

The trial was laid out with vegetable crops namely Ridge gourd, bitter gourd and cucumber as intercrops in cashew orchard in Kharif season at Vengurla. The details of yield of intercrops are present in Table 2.8.

Growing the intercrops has not affected cashew yield so far.

Table 2.7. Yield of intercrops at three levels of fertilizers at Bhubaneswar centre.

Treatments	Fertilizer levels			Mean
	0	1	2	
1. Sesamum	2.2	5.4	4.1	3.9
2. Horsegram	4.6	7.4	6.5	6.1
3. Blackgram	1.9	4.3	4.0	3.4
Mean	2.2	4.2	3.6	

Recommended fertilizer doses (kg/ha) for intercrops at Bhubaneswar centre.

	N	P ₂ O ₅	K ₂ O
1. Sesamum	30	15	15
2. Horsegram	12	25	0
3. Blackgram	20	40	0

Table 2.8. Yield of intercrop (kg/ha) at Vengurla centre.

Intercrops	Yield Kg/ha
1. Ridge gourd	2700
2. Bitter gourd	1620
3. Cucumber	3038

B. HORTICULTURE

Project Title : Hort. 1 : Vegetative propagation trial

Centres :

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

Objectives :

1. To find out the suitable grafting method and best season for propagation under different agroclimatic conditions.
2. To study the feasibility of producing cashew grafts during off season by utilizing green scions, decapitated scions etc.
3. To increase the percentage of graft

success during drier period by using low cost humidity chamber etc.

Soft wood grafting :

As per the decision of the XII Biennial Workshop held during October 1995 at Kasaragod, this project would be discontinued in all the centres as softwood grafting has been standardized for commercial multiplication of cashew grafts.

Project Title : Hort. 3 : Top working trial in cashew

Top working experiments were initiated to study the possibility of rejuvenating the unproductive cashew trees by grafting with high yielding clones. The results of trials at Madakkathara and Vengurla centres are reported here. Grown up trees which were uneconomical and unproductive were beheaded and the new sprouts emerging from the remaining part of the trunk were utilized for grafting. Grafting was done by adopting soft wood grafting technique with the elite scion material available at the centre. After beheading of the trees Bordeaux paste (10%) or Blitox solution was smeared over cut surfaces of the stumps to avoid invasion of fungal pathogens, if any and rest of the exposed portion of the trunk and roots were swabbed with Lindane.

working were

- Below 5 years
- 5 - 10 years
- 10 - 15 years
- 15 - 20 years

Beheading of the trees was tried at two heights.

- 0.5 m above ground level
- 1.0 m above ground level

Period of top working

- April - June
- September - October

Madakkathara

Highest graft success (80%) of top working was observed during the period between April to June in both the age groups (5-10 years and 10-15 years) tried. Growth of the grafted shoots was also good in the case of shoots grafted during April. Top worked

The age group of trees used for top

trees started yielding second year onwards. During 4th year on an average the yield was 4 kg per tree. Thereafter there was decline in yield. In the large plot trial on top working only 11 trees out of 35 survived and the rest were lost due to stem and root borer infestation. The mean yield of surviving trees for the last 5 years was only 1.6 kg per tree.

Vengurla

Among four different age groups of trees used for top working (below 5 years, 5-10 years, 10-15 years and 15-20 years) during

1988, the trees of 5-10 years age performed better as yield was better in those trees. During the fruiting season 1996 ten top worked trees (V-4 variety) were observed for their yield performance. Seven year old top worked trees produced an average yield of 6.9 kg/tree with a highest yield upto 9.4 kg/tree.

As per the decision of XII Biennial workshop held in October 1995, top working trial would be discontinued in all the centres.

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

Centres :

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

Objectives :

The objective of the trial is to identify dwarfing characters in cashew by 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.

As per the decisions of the XII Biennial Workshop 1995 the four centres were to take up inbreeding programme by resorting to selfing in the identified dwarf trees to enable selection of truly dwarf seedlings at respective centres.

Bhubaneswar

Dwarf type was identified during survey and studies will be initiated.

Madakkathara

The morphological and anatomical

characters of the seedlings at nursery stage were studied. The growth pattern of less vigorous types were compared with the vigorous types. Based on that, two varieties Tree No.2286 and Kariyarappatta were selected.

The seedling raised from Tree no. 2286 seem to be a better dwarf type than Kariyarappatta though morphologically the two were similar in appearance (Table 2.9). Seeds from Kariyarappatta (25 seeds) and Tree no. 2286 (20 seeds) were collected to raise rootstocks for grafting with scions of mother trees as well as vigorous ones for comparative evaluation under field conditions.

Inbreeding by selfing the two dwarf lines was attempted but no seed set was reported. Among the new Brazil collections planted in August 1993 no dwarf lines could

Table 2.9. Growth characters of less vigorous dwarf cashew types in the field at Madakkathara centre.

	Variety/Types		Height (m)	Girth (cm)	Spread (m)		Branches (nos.)
					E.W.	N.S.	
1.	Tree No, 2286	1	2.7	50	3.7	5.2	2
		2	2.8	45	4.9	5.3	3
2.	Kariyarappatta	1	4.4	60	3.8	4.5	5
		2	3.5	50	4.5	6.0	4

be identified based on growth characters (Table 2.10).

Vengurla

The seedlings raised from seednuts of dwarf and vigorously growing trees were screened for morphological and anatomical characters at nursery stage. No significant

difference regarding height, girth, stomatal count and total phenol content was noticed. As per the recommendations of Group discussion, the grafts prepared on such rootstocks (dwarf and vigorous) were planted in the year 1992. The growth parameters like height and girth were recorded (Table 2.11).

Table 2.10. Growth characters of New Brazil accessions at Madakkathara during 1995-96.

Sl.No.	Height (m)	Girth (cm)	Spread (m)		No. of primary branches
			E.W.	N.S.	
B2	3.3	40	2.8	2.9	2
B3	3.5	30	3.5	3.2	2
B4	5.5	40	1.0	3.4	—
B5	3.3	30	4.0	3.4	2
B6	4.5	35	3.7	3.9	2
B7	4.5	35	3.9	4.0	2
B9	2.0	20	1.0	1.0	4
B10	4.6	20	4.1	2.9	2
B11	4.5	30	2.9	3.1	2
B12	3.4	25	1.0	1.9	7
B13	2.5	15	1.1	1.6	—
B14	2.8	20	2.3	1.5	2
B15	3.5	30	2.3	2.5	3
B16	4.5	30	2.4	2.3	—
B17	2.8	25	2.5	2.6	3
B18	3.7	25	3.5	3.2	2
B19	2.4	10	1.3	1.6	—
B20	1.1	5	1.2	1.2	—

* Note : B1 and B8 accessions dried out

Table 2.11. Root stock screening for dwarfing characters in cashew at Vengurla centre.

Sl. No.	Root stock	Initial height Aug. 92 (cm)	Height taken in (cm)		Increase in height (cm)	Girth taken in (cm)		Increase in girth (cm)
			July 94	July 95		July 94	July 95	
1.	Vengurla-1	28	133	241	213	14.0	27.3	13.3
2.	Vengurla-2	32	158	240	208	18.0	30.3	12.3
3.	V-3	38	172	262	224	15.3	26.3	11.0
4.	V-4	29	162	293	264	13.8	26.8	13.1
5.	V-5	32	150	195	163	13.3	22.8	9.5
6.	T-40	33	175	269	236	16.8	29.8	13.0
7.	M-44/3	30	136	232	202	12.6	24.0	11.4
8.	Hy-1600	26	142	246	220	13.5	28.6	15.1
9.	VTH-59/2	34	150	255	221	13.5	26.8	13.3
10.	Hy-2/16	31	157	270	239	15.8	29.2	13.4
11.	T-129	26	155	216	190	16.5	23.6	7.1
12.	Hy-1608	31	128	285	254	12.4	26.4	14.0
13.	Hy-1610	37	138	314	277	12.4	19.2	7.2
14.	VTH-30/4	34	170	292	258	16.0	23.3	7.3
15.	M-26/2	31	160	253	222	13.0	19.4	6.4
16.	Hy-2/15	32	165	225	193	13.5	22.0	8.5

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

Centres :

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

Objectives :

The project is aimed at finding out an effective spray schedule for the management of tea mosquito bug and other minor

pests of cashew. The project also aims at testing the efficacy of plant products (neem and pongamia) against pests of cashew.

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

Treatments :

- T1 - Monocrotophos (0.05%) - one spray at flushing.
- T2 - Endosulfan (0.05%) - one spray at flowering
- T3 - Carbaryl (0.10%) - one spray at fruiting
- T4 - T1 and T2
- T5 - T1, T2 and T3
- T6 - T1 and T3
- T7 - T2 and T3
- T8 - Endosulfan (0.05%) at flowering stage followed by neem oil (2%) at fruiting stage.
- T9 - Carbaryl (0.1%) at flowering stage followed by neem oil (2%) at fruiting stage
- T10 - Control

ment was T5 at Jhargram (East coast) (2.6% incidence) and Vengurla (West coast) (2.5% incidence) centres. At Madakkathara (West coast) T8 had minimum incidence of the pest (37.9% incidence) whereas at Jagdalpur (maidan parts) it was minimum in T3 (6.5% incidence) treatment (Table 3.1).

In Bhubaneswar and Vridhachalam, incidence of the pest was minimum during this year.

The second best treatment was T4 (two spray schedule) in Jhargram, Vengurla and Madakkathara centres whereas in Jagdalpur it was T5 treatment.

The insecticidal treatments were given as per the above details and tea mosquito incidence recorded after three months of commencement of the experiment is presented in Table 3.1. The most effective treat-

Neem oil was tested in Madakkathara, Vengurla and Jagdalpur centres along with insecticidal sprays (T8 and T9). The incidence of tea mosquito bug was lowest (37.9% incidence) in T8 at Madakkathara centre indicating efficacy of this plant product.

Table 3.1. Effect of insecticidal treatment on the incidence of tea mosquito bug *H.antonii*

Treatment	Incidence percentage						No. of centres reported as		
	East Coast		West Coast		Maidan		Most effective	Second best	Third best
	Jhargram	Madakkathara	Vengurla	Jagdarpur	Jagdarpur				
T1	10.3(3.2)	Skipped	7.5(15.8)	14.4	—	—	—	—	
T2	10.8(3.2)	53.9	5.1(12.6)	11.4	—	—	—	1	
T3	11.2(3.4)	67.9	6.5(14.6)	6.5	1	—	—	—	
T4	3.0(2.1)	52.9	2.8(9.6)	11.1	—	—	3	—	
T5	2.6(3.4)	73.0	2.5(9.0)	6.7	2	—	1	—	
T6	7.0(2.8)	72.2	5.1(12.6)	6.8	—	—	—	2	
T7	7.9(2.4)	60.7	5.0(12.8)	7.0	—	—	—	1	
T8	—	37.9	6.0(14.2)	13.0	1	—	—	—	
T9	—	55.2	5.8(13.7)	13.3	—	—	—	—	
T10	14.4(2.6)	95.5	9.2(17.6)	14.0	—	—	—	—	
CD 5%	(0.60)		(4.20)						

Figures in parenthesis are transformed values

Centres :

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

In the experiment-1, observations were also made for incidence of various minor pests. The findings are given below:

Leaf miner (*Acrocercops syngamma*)

Incidence of this pest was noticed in Jhargram, of east coast and Madakkathara of west coast during this year. The incidence was lower in T4 (2.6%), T5 (2.6%) and T1 (3.9%) treatments at Jhargram whereas it was lower in T2 (6.7%), T3 (6.7%) and T6 (7.2%) treatments at Madakkathara centre (Table 3.2).

Leaf and blossom webber (*Lamida monocusalis*)

This pest was also recorded at Jhargram and Madakkathara centres during flushing and flowering periods. The incidence of the pest was lowest in T5 (1.2% and 0.8% least in Jhargram and Madakkathara locations respectively) treatment whereas next best was T4 treatment at Jhargram and T7 treatment at Madakkathara. The first two sprays were crucial for bringing down the population and further damage by this pest (Table 3.2).

Shoot tip caterpillar (*Hypotima haligramma*)

This pest was noticed in east coast regions of the country and the incidence was more during flushing and flowering periods. In Bapatla and Bhubaneswar centres, incidence was lowest in T1 (1.0% and 0.6% respectively) treatment. The second best treatments were T2 and T3 at Bapatla and it was T4 at Bhubaneswar. Skipping the first spray of monocrotophos increased the inci-

dence of this pest at Bapatla centre (Table 3.2).

Leaf roller

Incidence of this pest was noticed in Madakkathara centre in mild form. The lowest incidence was in T3 (1.8% incidence) followed by T4 (2.4%) and T2 (2.7%) treatments (Table 3.3).

Leaf weevil

At flushing stage leaf weevils were found damaging the cashew plantations at Bapatla. The incidence was reduced to 3.1% by monocrotophos (0.1%) at flushing and Endosulfan (0.1%) at flowering stage (T4). The next best alternative was T1 treatment (Table 3.3).

Inflorescence thrips

This pest was noticed both in east and west coasts during flowering and fruiting stages. At Bhubaneswar both yellow thrips (*Frankliniella schultzei* Trybom) and black thrips (*Haplothrips ceylonicus* Schumtze) were found feeding on the panicles. The lowest incidence of yellow thrips was in T3 and that of black thrips was in T5 treatments (Table 3.3).

In west coast, T3 (Madakkathara) and T6 (Vengurla) were the best treatments against this pest.

Apple and nut borer (*Thylocoptila panerosema*)

Incidence of this pest was noticed in Jhargram centre. The infestation was lowest in T5 followed by T7 treatment (Table 3.3).

Table 3.2. Effect of insecticidal treatments on the incidence of leafminer, leaf and blossom webber and shoot tip caterpillar

	Incidence percentage			Incidence percentage			Incidence percentage		
	Leaf miner			Leaf and blossom webber			Shoot tip caterpillar		
	East coast Jhargram	West coast Madakkathara	East coast Jhargram	West Coast Madakkathara	East Coast Bapatla	West Coast Madakkathara	East Coast Bapatla	West Coast Madakkathara	East Coast Bhubaneswar
T1	3.9 (2.1)	—	4.9 (6.6)	—	1.0	—	1.0	—	0.6 (1.0)
T2	6.7 (2.6)	6.7	3.5 (1.9)	2.8	3.5	2.8	3.5	2.8	4.8 (2.8)
T3	8.9 (2.9)	6.7	5.0 (2.2)	7.4	3.5	7.4	3.5	7.4	4.9 (2.3)
T4	2.6 (1.7)	10.0	1.3 (1.2)	2.0	7.0	2.0	7.0	2.0	2.0 (1.5)
T5	2.6 (1.7)	13.3	1.2 (1.1)	0.8	6.0	0.8	6.0	0.8	4.7 (2.1)
T6	5.8 (3.7)	7.2	2.4 (1.5)	2.1	3.5	2.1	3.5	2.1	4.4 (2.2)
T7	6.4 (2.4)	10.7	4.5 (2.1)	1.8	21.5	1.8	21.5	1.8	7.0 (2.5)
T8	—	7.8	—	2.7	4.0	2.7	4.0	2.7	7.5 (2.8)
T9	—	12.5	—	3.7	11.0	3.7	11.0	3.7	4.8 (2.2)
T10	14.6 (2.7)	13.5	11.0 (9.7)	2.5	7.5	2.5	7.5	2.5	9.3 (3.1)
CD 5%			(0.12)						(1.24)

Figures in parenthesis are transformed values

Table 3.3. Effect of insecticidal treatments on the incidence of leaf roller, leaf weevil, inflorescence thrips and apple and nut borer

	Leaf roller		Leaf weevil		Inflorescence thrips			West coast		Apple and nut borer	
	West coast	Madakkathara (%)	East coast	Bapatla (%)	East coast	Bhubaneswar (YT)	Bhubaneswar (BT)	Madakkathara	Vengurla (% area)*	East coast	Jhargram (%)
					No/inflorescence	No/inflorescence	No/inflorescence	No/inflorescence			
T1	—		3.6		0.3 (0.9)	0.5 (1.0)	—		24.3 (29.6)		6.2 (7.5)
T2	2.7		6.2		0.2 (0.8)	0.5 (1.0)	3.5		23.5 (28.4)		4.0 (2.0)
T3	1.8		5.9		0.0 (0.7)	0.5 (1.0)	3.3		20.1 (26.6)		2.4 (1.6)
T4	2.4		3.1		0.1 (0.8)	0.8 (1.1)	4.1		18.6 (25.6)		1.5 (1.2)
T5	3.3		5.7		0.0 (0.7)	0.3 (1.0)	5.0		14.0 (22.0)		0.5 (0.7)
T6	3.1		5.5		0.0 (0.7)	0.9 (1.2)	4.1		11.5 (19.1)		1.6 (3.8)
T7	3.1		6.2		0.1 (0.8)	0.5 (1.0)	8.8		13.4 (21.4)		0.5 (1.9)
T8	3.7		9.1		0.5 (1.0)	0.3 (0.9)	10.3		15.5 (23.2)		—
T9	4.4		8.2		0.5 (1.0)	0.3 (0.9)	4.8		17.9 (25.0)		—
T10	5.2		7.1		0.5 (1.0)	1.6 (1.5)	11.4		27.0 (31.3)		7.6 (2.6)
CD 5%					(0.19)	(0.24)			(3.30)		(0.09)

YT - Yellow thrips, BT - Black thrips, * % area damaged on nuts (Figures in parentheses are transformed values)

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

Centres :

- East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast : Vengurla, Madakkathara
Maidan tracts : Jagdalpur

Treatments :

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

Tea mosquito bug

Comparison of recommended spray schedule was made with various neem based products at Bhubaneswar, Vridhachalam and Vengurla centres. In

Bhubaneswar, incidence of tea mosquito bug on panicle and nuts/apple was lowest in T5 which was followed by T6 and T7 treatments. Similar trend was also noticed in Vengurla centre (Table 3.4).

Shoot tip caterpillar

Incidence of the pest was noticed in Bhubaneswar which was lowest in T5 treatment. The next best treatments were T2 and T3 (Table 3.4).

Inflorescence thrips

Incidence of inflorescence or flower thrips was noticed both in east (Bhubaneswar) and west coasts (Vengurla). T5 was found to be the most effective treatment in both the centres. The second best alternative was T2 at Bhubaneswar and T6 at Vengurla centres (Table 3.4).

Table 3.4. Control of foliage/inflorescence pests with neem products

	Tea mosquito bug		Shoot tip caterpillar		Inflorescence thrips	
	Panicle (%)	Nut and apple (%)	West Coast Vengurla (%)	East coast Bhubaneswar (%)	East coast Bhubaneswar (%)	West coast Vengurla (%)
T1	36.7 (36.1)	11.1 (11.7)	5.9 (13.4)	1.4 (1.2)	0.5 (1.0)	26.1 (30.7)
T2	41.2 (39.8)	16.7 (15.0)	6.0 (14.1)	0.6 (1.0)	0.3 (0.9)	31.5 (34.1)
T3	41.0 (39.8)	8.3 (10.0)	6.2 (6.5)	0.7 (1.0)	0.3 (0.9)	29.7 (33.0)
T4	42.1 (40.8)	13.0 (17.4)	6.5 (14.7)	0.7 (1.0)	0.4 (1.0)	30.1 (33.2)
T5	9.4 (17.8)	4.8 (7.4)	3.2 (10.2)	0.6 (1.0)	0.2 (0.8)	19.5 (26.3)
T6	20.1 (25.8)	5.6 (8.0)	4.5 (12.2)	1.2 (1.2)	0.3 (0.9)	25.9 (30.5)
T7	22.2 (24.9)	8.3 (10.0)	5.1 (12.9)	0.7 (1.0)	0.4 (0.9)	28.1 (31.8)
T8	47.3 (43.4)	38.7 (38.4)	18.5 (25.4)	9.1 (3.0)	0.8 (1.1)	38.2 (38.2)
CD 5%			(5.85)		(0.18)	(5.46)

Figures in parenthesis are transformed values

Project Title : Ent. 2 : Control of stem and root borers
Expt.1 : Prophylactic control trials

Centres :

East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast : Madakkathara and Vengurla

The prophylactic treatment with neem oil 5% and neem seed kernel extract 5% prevented fresh attack by cashew stem borers at Bapatla. Treatment with carbaryl (0.2%) in mud slurry resulted in lowest fresh attack of 8.0 per cent at Bhubaneswar centre; while neem oil 5% swabbing was the next

best (24.0%) in contrast to 44.0 per cent attack in untreated control (Table 3.5).

Neem oil (5%) swabbing alone or along with sevidol 4 G application prevented fresh incidence and was the most effective treatment at Jhargram centre

Table 3.5. Influence of prophylactic treatments on incidence of cashew stem and root borer.

Prophylactic treatments	% freshly infested trees			
	East coast centres			West coast centres
	Bapatla	Bhubaneswar	Jhargram	Madakkathara
T1-Carbaryl (0.2%) in mudslurry	26.6	8.0	0.0	0.0
T2-Swabbing carbaryl (0.2%)+sevidol 4G application	0.0	24.0	0.0	0.0
T3-Swabbing neem oil 5% + sevidol 4G application	0.0	0.0	0.0	0.0
T4-Neem oil 5%	0.0	24.0	0.0	4.0
T5-Neem cake extract 5%	16.6	32.0	10.0	8.0
T6-Neem seed kernel extract 5%	13.3	40.0	10.0	8.0
T7-Untreated control	40.0	44.0	20.0	24.0

(Table 3.5). In West Coast centres at Madakkathara centre, lowest attack (4.0%) was recorded in Neem oil (5%).

There were no trees with advanced stage of attack by stem and root borer in the treatment with carbaryl (0.2%) in mud slurry in Bhubaneswar centre (Table 3.6). In

Jhargram centre, neem oil (5%) and neem seed kernel extract (5%) treated trees showed only early stages of infestation by stem and root borer (Table 3.6).

The experiment is in progress at Vengurla and Vridhachalam centres.

Table 3.6. Stages of attack by cashew stem and root borer under various prophylactic treatments.

Prophylactic treatments	% infested trees in each stage									
	Bhubaneswar					Jhargram				
	Early	Middle	Advanced	Dead	Early	Middle	Advanced	Dead		
T1-Carbaryl(0.2%) in mudslurry	0.0	4.0	0.0	0.0	-	-	-	-		
T2-Swabbing carbaryl(0.2%) + Sevidol 4G application	2.0	10.0	-	0.0	-	-	-	-		
T3-Swabbing neem oil (5.0%) +Sevidol 4G application	-	-	-	-	0.0	0.0	0.0	0.0		
T4-Neem oil 5%	4.0	6.0	2.0	0.0	5.0	0.0	0.0	0.0		
T5-Neem cake extract 5%	8.0	8.0	-	0.0	5.0	5.0	0.0	0.0		
T6-Neem seed kernel extract 5%	4.0	14.0	2.0	0.0	10.0	0.0	0.0	0.0		
T7-Untreated control	6.0	14.0	2.0	0.0	10.0	5.0	5.0	0.0		

Project Title : Ent. 3. : Bioecology of pests of regional importance and survey of pestcomplex and the natural enemies.

Centres :

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

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

The pest was recorded throughout the year causing low to high attack in east coast centres as well as in West coast centres.

2. Tea mosquito bug (*Helopeltis antonii*)

The most important foliage pest, TMB was recorded in varying populations from all centres except Bapatla. The east coast centre, Vridhachalam had the pest incidence during April-October and January-March, in the year 1995-96 (Fig. 1). Vengurla on the West Coast, had low incidence during August-November and high incidence from December-March. The correlations worked out at Chintamani revealed maximum temperature and R.H. to be negatively correlated to pest occurrence.

3. Leaf miner (*Acrocercops syngamma*)

The incidence was very rare in Bapatla centre while at the other east coast centres moderate incidence during August-March was noticed. (Fig. 2) The incidence was low at Vengurla and moderate at Madakkathara on the West coast during July-Feb. Incidence of this pest was noticed during May to July and was moderate at the plains.

4. Leaf and blossom webber (*Lamida moncusalis*)

The pest occurrence of low to high was recorded during April-March (42.0%

infested branches) from east coast centres. The intensity of attack was comparatively high at Jhargram centre (Fig. 3). The West coast centres had pest attack during November-January in lower proportions and the incidence was moderate in the plains during February-March.

5. Apple and nut borer (*Thylocoptila panerosema* and *Nephopteryx* spp.)

The borer pest was encountered in all the centres except at Jagdalpur. The intensity of attack was low to moderate during fruiting season from Jan/Feb-May. The per cent fruit attack was below 5.0 in majority of the centres.

6. Aphids (*Toxoptera odinae*)

The aphids were noticed at almost all east coast centres in low numbers, at Vridhachalam the damage was (5.5 - 25.2%) during April-May and January-February. The pest also prevailed on west coast (at Vengurla) during December-February and in plains (at Jagdalpur) from July-September at lower levels.

7. Shoot tip caterpillar (*Hypotima haligramma*)

The pest occurred exclusively on the east coast. The season of attack was April-March, causing low to severe damage. Upto 19 percent of shoot tips were damaged at

Bhubaneswar centre severely during May-October (Fig. 4).

8. Leaf thrips (*Rhipiphorothrips cruentatus*)

The thrips incidence was low in east coast centres with the exception of moderate incidence of leaf thrips at Jhargram and Vridhachalam during January to April. Leaf thrips were not encountered on west coast and at plains.

9. Flower thrips (*Rhynchothrips rapensis*)

The flower thrips were observed to cause high damage at Vengurla and Madakkathara centres on west coast, during December-April. However, their presence was lower at the east coast centres, and was noticed during January-April.

10. Leaf weevil (*Myllocerus* spp.)

The pest prevailed during flushing period in low numbers at Jhargram and Vridhachalam centres.

11. Leaf folder (*Caloptilea tiselea*)

The pest was recorded from Bapatla and Jhargram on the east coast in low to moderate to high levels, during July-February. The period of occurrence at Madakkathara on west coast was September-December causing moderate damage.

12. Hairy caterpillars

Occurrence of the sporadic pest; hairy caterpillar *Estigmene lactinea* was noticed during October-March at the east coast centres of Jhargram and Vridhachalam causing moderate damage on the foliage. Occurrence of the pest in the west coast was noticed from November-February in

Vengurla centre causing low damage. The pest occurred in low numbers during February at Jagdalpur representing the plains.

13. Mealy bug (*Ferrisia virgata*)

The pest infested the inflorescence and was encountered from April-June and February-March causing moderate attack at Vridhachalam. The period of occurrence on west coast was February-March with a low level of incidence.

14. Termites (*Odontotermes* sp.)

The occurrence of termites was low at Bhubaneswar and Bapatla. At Jhargram on east coast, attacking the main trunk of the tree during October-May. The occurrence was moderate with *Microtermes pakistanicus* recorded from Jagdalpur, being present all round the year.

15. Root grubs (*Holotrichia consanguina*)

The pest occurred at low incidence level during June-July at Jagdalpur representing the plains.

16. Leaf beetle (*Monolepta longitarsus*)

The leaf beetle incidence was observed at Bhubaneswar on east coast during May-July and July-December at Jhargram and at Vengurla centre on west coast during July-August months. The incidence was at low levels, at both the centres.

17. Bark caterpillar (*Inderbela tetraonis*)

Incidence of the pest was throughout the year causing moderate damage in the plains. The pest occurred during October-March at Jhargram and also found at Bhubaneswar, causing low damage (2-5 per cent of trees).

Fig. 3 Seasonal occurrence of shoot tip
Tea mosquito bug (*Helopeltis anfonil*)
on panicles at various centres

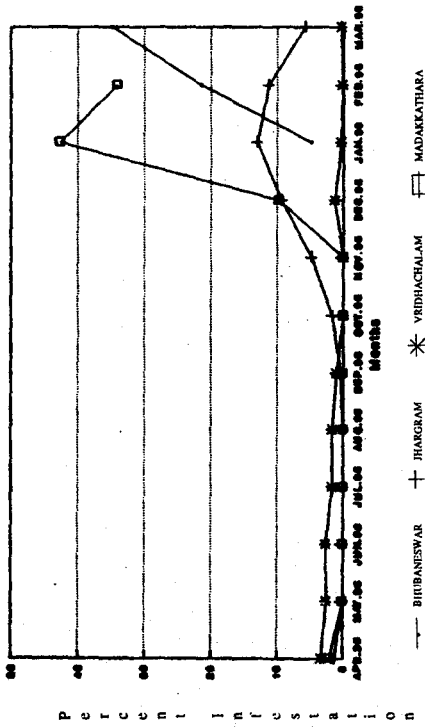
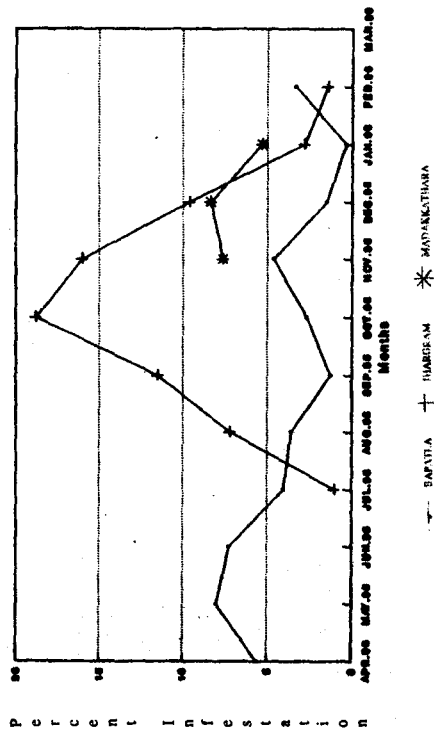


Fig. 3 Seasonal occurrence of leaf and
blossom webber (*Lamida monoculalis*)
on shoots at various centres



(*Acrocercops syngamma*)
at various centres

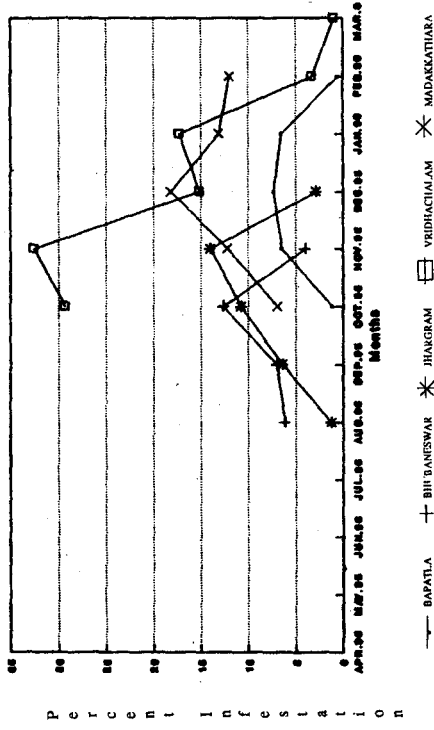
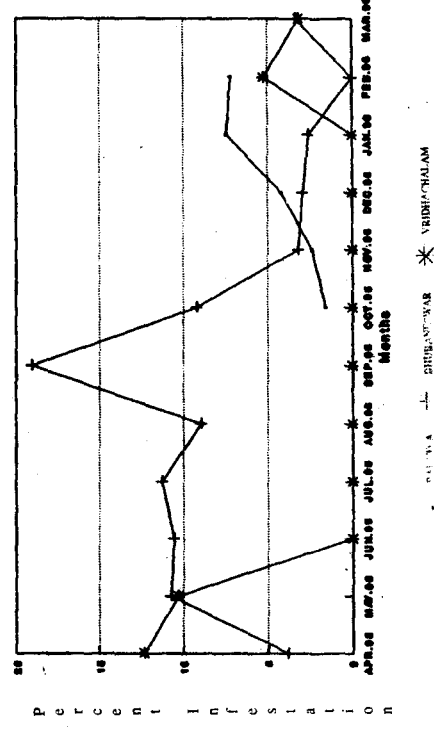


Fig. 4 Seasonal occurrence of shoot tip
caterpillar (*Hypotima haligramma*)
at various centres



18. **Leaf twisting weevil (*Apoderus tranquebaricus*)**

This pest was noticed only at Jhargram centre during August-November causing low levels of damage. The other minor pests such as semilooper, *Thallasodes quadrialis* occurred at Jhargram during November-February in low numbers. Also plant bug, *Nezara viridulata*; scale, *Planococcus citri*; gundhi bug, *Lepto corisa acuta* as well as the leaf mite, *oligonychus acuta* have been reported from this centre.

Natural enemies

The various natural enemies as coccinellids, spiders, ants, syrphids and other parasitoids recorded at the different AICRP centres have been mentioned (Table 3.7).

Coccinellids

The coccinellid beetles have been reported preying on aphids or being present in canopy from the east coast centres except Bapatla. Occurrence was noticed mainly during December-May. The presence of coccinellids was also reported from Jagdalpur centre from February-March.

Spiders

Different species of spiders on leaf and blossom webber was recorded from Jhargram. The other east coast centres (except Bapatla) also recorded spiders to be

present during most part of the year.

The presence of spiders was recorded throughout the year from Madakkathara centre.

Ants

Different ant species in cashew canopy were reported by different centres. However, the black ant was reported preying on leaf miner from Jhargram centre.

Parasitoid species

Sympiesis sp. was recorded to parasitise the leaf miner and *Bracon brevicornis* on leaf webber from Bhubaneswar centre. *Apanteles* on leaf and blossom webber was reported from Jhargram and Vridhachalam centres, during August-March. The occurrence of tachinid parasite on shoot and blossom webber was reported from Jhargram, alongwith *Bracon brevicornis* on the same host during August-March.

Mirids

Mirids were recorded from Bhubaneswar and Madakkathara, during December-March and December-January respectively but, their host specificity was not confirmed. Preying mantis, and the beneficial honeybees were recorded from Jagdalpur and Madakkathara centres during January-March, and December-January-April respectively.

Table 3.7. Occurrence of natural enemies of cashew pests at various centres.

Pest encountered	East coast centres				West coast centres				Plains
	Bapatla	Bhubaneswar	Jhargram	Vridhachalam	Vengurla	Madakkathara	Jagdalspur		
1. Lady bird beetles/ coccinellids (Coccinellidae: coleoptera)	P —	Dec.to Mar.	Jan.to Mar.	Nov.to May	—	—	Feb.to Mar.	—	—
2. Spiders	H	Aphids	Aphids	—	—	—	Aphids	—	—
3. Ants	P	Jul.to Apr.	Nov.to Jan.	Mar.to Apr.	—	Jan.to Dec.*	General predator	—	—
4. Syrphids	H	—	Shoot & blossom webber	General predators	—	—	—	—	—
5. Parasitoids i) <i>Sympiesis</i> spp	P	Jun.to Apr.	Oct.to Dec.	—	—	Jan.to Dec.*	—	—	—
	H	—	Black ant on the leafminer	—	—	—	—	—	—
	P	—	—	Jan.to Jun.	—	—	—	—	—
	H	Aug. to Nov.	—	—	—	—	—	—	—
	P	—	—	—	—	—	—	—	—
	H	Leaf miner	—	—	—	—	—	—	—

Table 3.7. Contd.

Pest encountered	East coast centres			West coast			Plains
	Bapatla	Bhubaneswar	Jhargram	Vridhachalam	Vengurla	Madakkathara	
ii) <i>Apanteles</i> sp	P		Aug. to Mar.	Aug. to Mar.			
	H		Leaf and blossom webber	Leaf and blossom webber			
iii) <i>Bracon brevicornis</i>	P	Apr. to Jun.	Aug. to Mar.				
	H	Leaf and blossom webber	Shoot and blossom webber				

P = Period of occurrence

H = Host on which noticed

* Except July

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

Centres :

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

Objectives :

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

Bapatla

Data were recorded at fortnightly intervals for the 17 germplasm accessions in seven years age group, 12 in four years age group and 20 in three years age group. Prominent pests recorded were:

- (i) *Lamida monocusalis* (ii) *Myllocerus* sp.
(iii) *Hypotima haligramma* (iv) *Nephopteryx* sp.

The accessions in the 3 years age group which have come to bearing were screened for major pests i.e. *Lamida monocusalis*, *Myllocerus* sp. and *Hypotima haligramma* (Table 3.8).

Among the germplasm accessions in four years age group, per cent infestation of *Hypotima haligramma* on panicles was found to range from zero (VP1) to 8.5 per cent (SK7).

In the seven years age group, AP-19 showed resistance to *Nephopteryx* sp (0.6%) and to *Hypotima haligramma* (0.5%) on nuts during 1994-95 and also during 1995-96 under sufficient pest load (Table 3.8).

Bhubaneswar

Sixteen MLT entries and twenty six

germplasm accessions were screened for resistance against shoot tip caterpillar and tea mosquito bug at the centre (Table 3.9 and 3.10).

Among the 16 MLT entries H-1600 showed the least damage of 6.5 per cent shoot infestation by shoot tip caterpillar followed by H-1598 (7.6%) and H-1608 (7.9%).

The types V-4 and V-5 were highly susceptible (the per cent shoot infestation were 23.9 and 25.3 respectively).

The incidence of TMB was very low in these entries. In H-1610 a infestation of 10.4 per cent on shoots and 2.5 per cent on panicles were noticed.

Among the 26 germplasm accessions screened (Table 3.10) none of the accessions were found to be free from attack of shoot tip caterpillar. However, in OC-11 the least damage of 4.1 per cent (shoot infestation) followed by OC-25 (4.1%), OC-15(5.3%), OC-16(5.9%) and OC-17 (6.3%) was recorded. OC-15, OC-19, OC-28 and OC-33 were free from attack of TMB. The accessions OC-4 (48.2%) and OC-5 (30.4%) were highly susceptible to TMB attack.

Jhargram

Germplasm types were screened during the year against shoot tip caterpillar and

Table 3.8. Screening of germplasm for major pests at Bapatla centre.

Sl. No.	Entries	Seven years age group			Four years age group			
		Mean % of nuts damaged by <i>Lamida monocalis</i>	Population of <i>Nephopteryx sp.</i>	Population of <i>Hypotima haligramma</i>	Percentage of nuts damaged by <i>H. haligramma</i>	Entries	Percentage of infestation by <i>Mylocerus sp.</i>	<i>H. haligramma</i>
1	AP6	3.6	12.2	4.0	5.8	EG1	0.5	2.0
2	KO1/5	1.5	11.6	9.0	8.3	EG2	1.0	1.5
3	Hy7/3	0.6	6.1	10.0	18.5	EG3	3.5	3.0
4	Hy12/6	—	6.8	11.3	28.8	VP1	0.5	Nil
5	T.210	1.7	5.2	8.0	31.3	VP2	6.5	2.5
6	T.282	2.8	4.7	6.3	24.0	VP4	4.0	2.0
7	Hy3/6	0.6	10.6	6.3	4.3	SK1	0.5	0.5
8	Hy4/3	1.1	8.1	8.0	2.7	SK2	-	4.5
9	Hy3/4	0.5	1.6	8.7	4.9	SK3	0.5	2.5
10.	GG4/4	0.5	3.2	6.0	—	SK7	0.5	8.5
11.	GG3/10	—	1.7	9.0	13.0	SK8	-	1.0
12.	AP19	1.6	0.6	4.0	0.5	VP6	2.0	3.0
13.	GG3/7	—	2.0	10.0	3.9	Radhaya-	0.5	1.0
14.	T71	4.8	4.1	9.0	4.5	palem		
15.	T241	—	3.3	4.3	5.4			
16.	T275	6.9	13.8	14.0	16.2			
17.	T129	—	—	11.0	4.8			

Table 3.9. Incidence of major pests of cashew in sixteen MLT entries screened for their resistance/ tolerance to the pests during 1995-96 at Bhubaneswar centre.

S. No.	Cashew types	Per cent shoot tip caterpillar infestation* (Shoots)	Percent Tea mosquito infestation	
			Shoots	Panicle
1	BPT-2/15	15.8	12.6	14.0
2	BPT-2/16	13.2	10.4	23.0
3	H-1598	7.6	0.0	0.0
4	H-1600	6.5	0.0	17.0
5	H-1608	7.9	0.0	1.3
6	H-1610	8.9	10.4	24.5
7	M-26/2	10.5	3.8	17.0
8	T.No.40	9.7	0.0	2.8
9	T.No.129	8.3	0.0	0.0
10	V-2	14.8	4.4	21.3
11	V-3	12.6	3.2	8.0
12	V-4	23.9	0.0	0.0
13	V-5	25.3	0.0	1.5
14	VRI-1	13.3	0.0	0.0
15	VTH 30/4	13.2	0.0	0.0
16	VTH 59/2	18.2	0.0	0.0

*Mean of three observations.

inflorescence thrip. Though the mean incidence was very low, none of them were found to be resistant. The range for mean incidence of shoot tip caterpillar was 2.8 to 12.4 and of inflorescence thrips was 4.3 to 11.5.

Vridhachalam

During the year the F1 hybrids of high yielding and tea mosquito bug (TMB) field tolerant types and 17 MLT entries and available germplasm accessions were screened for their tolerance to insects.

All the F1 hybrids were susceptible to shoot and blossom webber, tea mosquito bug, aphids, mealy bugs and leaf thrips (Table

3.11). The least Tea mosquito bug damage was observed in Hy 15 (M 26/1 x M 75/3) (Mean score value - 3.2) and highest damage in Hybrid 10 (M 10/4 x M 26/1) (Mean score value-4.0).

All the MLT entries screened were susceptible to major pests of the region. The least damage by TMB was noticed in VTH 59/2 with the mean score of 2.5 and the maximum score of 4.0 damage was observed in H 1610, V-5, V-3, T.129, H 2/16 and M 26/2. In the MLT entries the mean percent damage of shoot and blossom webber, aphids, mealy bugs ranged 20.2 to 52.3, 2.5 to 30.2 and 2.2 to 26.2 respectively and thrips damage ranged from 3.2 to 25.2.

Table 3.10. Incidence of major pests in some of the accessions screened for their resistance/tolerance at Bhubaneswar centre.

Sl. No.	Accession number	Percentage shoot tip caterpillar infestation* (Shoots)	Percentage TMB infestation (Panicle)
1	OC-1	10.2	10.5
2	OC-2	25.1	5.4
3	OC-3	12.7	7.6
4	OC-4	9.9	48.2
5	OC-5	30.2	30.4
6	OC-6	15.5	20.0
7	OC-7	13.9	7.1
8	OC-8	14.8	10.3
9	OC-9	14.5	6.4
10	OC-11	4.1	25.6
11	OC-12	8.4	20.3
12	OC-15	5.3	0.0
13	OC-16	5.9	8.7
14	OC-17	6.3	2.5
15	OC-19	26.4	0.0
16	OC-22	28.4	1.3
17	OC-23	10.9	20.0
18	OC-24	19.2	3.0
19	OC-25	4.1	1.5
20	OC-28	17.9	0.0
21	OC-33	25.1	0.0
22	OC-36	22.3	2.8
23	OC-38	11.7	5.9
24	OC-40	23.5	10.6
25	OC-41	23.2	13.6
26	OC-43	27.2	5.9

*Mean of three observations

Madakkathara

All the accessions planted during 1988 (Acc.nos. 15-50) and in 1989 (Acc. Nos. 51-82) were observed for tea mosquito infestation at monthly intervals on regular flushes during 1995-96. The yield was recorded during May and TMB incidence was ob-

served to be very high during January-February month (Table 3.12).

The varieties/types found to be comparatively tolerant/less susceptible, after testing in the field for natural infestation for last three years were, Madakkathara-1, H-3-

Table 3.11. Screening of F1 hybrids against major pests at Vrindhachalam centre.

Hybrid No.	Crosses	Percentage (mean) damage per quadrant by					TMB (Mean score)
		Shoot and blossom	Aphids (on shoots)	Mealybugs (on shoots)	Thrips (on leaves)		
10	M 10/4 x M 26/1	52.2	3.6	2.6	16.6	4.0	
11	M 10/4 x M 45/4	63.2	2.6	45.2	15.2	3.2	
12	M 10/4 x M 75/3	55.4	11.3	18.4	8.6	3.8	
13	M 44/3 x M 26/1	35.3	5.4	8.3	42.6	3.8	
14	M 26/1 x M 26/1	35.3	10.3	15.1	25.3	3.6	
15	M 26/1 x M 75/3	46.3	15.2	7.6	12.2	3.2	
16	M 44/3 x M 75/3	29.5	8.5	25.3	32.5	3.8	
17	M 44/3 x M 45/4	42.4	23.5	3.5	24.8	3.9	

Table 3.12. Tea mosquito infestation and yield values on less susceptible accessions at Madakkathara centre.

Sl. No.	Accession No.	Varieties/types	Mean infestation by TMB		
			Percentage (Oct.-April 1996)	Mean	Yield (kg) per tree 1994-95
1	17	Bzl-120	45.0	0.6	1.5
2	18	Bzl-239	39.1	0.5	1.5
3	22	Bzl-248(S)	32.3	0.2	1.4
4	25	Vapala	32.6	0.3	2.0
5	26	BLA-139-1	37.5	0.5	2.8
6	27	BLA-39-4	80.3	1.0	2.8
7	28	K-22-1	67.8	0.6	1.8
8	30	H-3-13	71.3	0.7	1.3
9	31	H-3-17	70.3	0.9	1.6
10	32	H-680	77.7	0.9	1.1
11	34	H-718	75.6	0.8	2.7
12	35	H-719	77.2	0.7	1.5
13	37	H-1588	72.2	0.8	1.2
14	38	H-1589	73.3	0.8	2.4
15	41	H-1596	88.5	0.8	1.9
16	42	H-1597	23.3	0.8	2.7
17	43	H-1598	25.0	0.8	1.3
18	44	H-1600	39.4	0.3	2.2
19	49	A-26-2	69.2	1.9	1.5
20	57	PU-8	45.5	1.4	1.2
21	58	Rajamundry	63.6	1.9	1.3
22	60	Bzl-18	11.8	0.4	1.1
23	75	H-8-1	70.0	1.7	1.8
24	73	H-3-9	18.7	0.4	1.9
25	81	H-9-3	11.3	0.1	0.9

17, H-718, H-1600, A-26-2, A-6-1, PU-8, K-10-1, H-8-1, H-8-7, H-8-8, H-8-15 and Tree no.856.

These varieties were subjected to field confinement test during November-December 1995 and reaction to feeding was noted in 0-4 scale.

Varieties A-26-2, H-8-8, H-718 and H-3-17 were found to be the promising lines

(Table 3.13).

Vengurla

In the field screening of germplasm against tea mosquito bug, the observations were recorded from 0.5 x 0.5 sq.m. marked area of the canopy on all the four sides of the tree during peak period of TMB incidence but none of the germplasm screened were found to be resistant against the pest. (Table 3.14).

Table 3.13. Mean score of TMB infestation on shoot and panicle in the field confinement studies at Madakkathara centre.

No.	Varieties	Mean score of TMB infestation	
		Shoot	Panicle
1	MAD-1	0.5	0.8
2	A-26-2	0.5	0.3
3	H-8-7	1.0	0.5
4	H-8-8	0.3	-
5	H-5-1	0.3	1.3
6	H-1600	1.8	-
7	H-718	0.5	-
8	K-10-1	1.0	1.0
9	H-3-17	0.3	1.0
10	PU-8	1.5	0.5
11	H-8-15	1.3	2.5
12	A-6	2.0	3.3
13	T-856	1.3	1.3

Table 3.14. Screening of the germplasm against tea mosquito bug at Vengurla centre.

Sl. No.	Type	Average score	Percent incidence
1	4-26	0.7	16.5
2	J-3	1.1	27.8
3	J-5	0.4	10.7
4	H-26(16-98)	0.2	6.0
5	CYT-195	0.2	4.6
6	H 2/16	0.7	17.1
7	T-129	0.7	18.5
8	Kolgaon	0.8	20.4
9	Kankadi	0.4	12.1
10	J-1	0.3	8.1
11	H-2/15	0.5	12.3
12	Taliparamba	0.3	6.3
13	J-15	0.4	12.4
14	J-6	0.6	12.8
15	J-2	0.5	12.3
16	CYT-176	0.3	6.3
17	Tulas	0.5	11.4
18	H-2/15	0.5	12.2

Project Title : Agr. 3 : Foliar application of urea along with insecticides

Centres :

East Coast : Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast : Vengurla

Objectives :

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

2% urea gave the maximum number of nuts and yield/tree (1787.5 and 9.6 kg/tree) and shelling percent (27.0 followed by T4 (8.5 kg), T3 (7.8 kg) and T1 (6.9 kg) for yield/tree (Table 4.1).

Experiment details :

Design : RBD

Replications : Four

The tea mosquito damage was not observed during this period.

Treatments

T1 : Soil applications 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 spray.

T4 : Soil application as above + 4% Urea and Endosulfan spray.

T5 : Soil application of 250g each of P₂O₅ and K₂O + 2% Urea and Endosulfan spray.

Among treatments, T2 has given maximum net returns per hectare (Rs.26,785.00) followed by T4 and T3. The net return per hectare was minimum in plot receiving T5 treatment (Rs. 16,458.00 in which no nitrogen was applied through soil (Table 4.2).

Bhubaneshwar

In the experiment conducted at Bhubaneshwar maximum number of flowering panicles were recorded in T2 treatment (20.4) followed by T3 (19.0) and was minimum in T5. The number of nuts also increased due to urea spraying (Table 4.3). Maximum number of nuts per tree was observed in T2 (4218) followed by T3 (4064), T4 (3653) and was minimum in T5 (2237) treatments. The average yield was recorded maximum in T2 (4.8 kg) followed by T3 (4.7 kg) and was minimum in T5 (2.5 kg) per plant. The shelling percent ranged from 30.3 to 30.7 in various treatments (Table 4.4). However minimum shelling percentage was recorded in T5 (30.3%) (Table 4.4). The leaf N

East Coast :

Bapatla

The experiment was laid out at Bapatla in 1989. The treatments did not affect production of flowering panicles/sq. metre, number of nuts and weight of nuts/tree and shelling percent. However, mean values for 2 years data revealed that foliar spray with

Table 4.1. Effect of foliar application of urea on yield and yield attributes and percent leaf Nitrogen in cashew at Bapatla centre.

Treatments	No. of flowering panicles/Sq.m.	No. of Nuts per tree	Yield kg/tree	Shelling %	% leaf N		% tea mosquito bug damage
					Before spray	After spray	
T1	20.5	1280.5	6.9	26.5	1.8	1.8	Nil
T2	22.2	1787.5	9.6	27.0	1.9	1.9	Nil
T3	22.5	1364.0	7.8	26.0	1.8	1.8	Nil
T4	21.9	1475.0	8.5	26.5	1.8	1.8	Nil
T5	16.7	1175.5	6.0	26.0	1.6	1.6	Nil
SEm(±)	2.13	281.00	1.54	0.46	-	-	Nil
CD at 5%	NS	NS	NS	NS	NS	NS	NS

Table 4.2. Economic feasibility of urea foliar spray at Bapatla centre.

Treatments	Cost of each treatment/ha (Rs.)	Gross returns (Rs.)	Net return (Rs.)
T1	1885	20700	18815
T2	2015	28800	26785
T3	2080	23400	21320
T4	2145	25500	23355
T5	1542	18000	16458

content of the leaves before spraying ranged from 1.6 in T5 to 1.7 per cent in T2 and T3 treatments. After sprayings of urea the leaf N content was minimum in T5 (1.5%) and was maximum in T3 (1.8) followed by T4 (1.8%) and T2 (1.8%) treatments (Table 4.4). Incidence of shoot tip caterpillar was maximum in T4 (16.5) followed by T3 (16.1) and minimum in T5 (10.0). The incidence of tea mosquito was maximum in T4 (25.1%) followed by T3 (18.3%) and minimum in T5 (8.6%) treatments.

Jhargram

In Jhargram it was observed that the

trees receiving the T2 treatment recorded the maximum number of panicle/sq.m (28.9) nuts/tree (1554.6), yield per tree(5.6 kg) and shelling percentage of 37.0 per cent (Table 4.5 and 4.6).

Pooled analysis of data showed that T2 treatment continued to give significantly higher yield over all the other treatments in all the three years (1992, 1993 and 1994).

Studies on economics showed that T2 treatment fetched Rs.3300 more income per acre of cashew plantation compared to the T3 treatment.

Vridhachalam

In Vridhachalam the mean number of flowering panicles produced per square metre varied significantly for the different treatments. Highest mean value of 31.0 per square metre was recorded in Treatment T4 (4% urea) which was on par with T3 (3% urea) (Table 4.7).

The number of nuts produced per tree was the highest in the treatments T4 (1769)

Table 4.3. Influence of foliar application of urea along with insecticide on flowering and yield at Bhubaneswar centre.

Treatment	Flowering panicles nos./sq.mt (Average of four years)	No. of Nuts/pl. by cumulative total for four years	No. of nuts average of four years	Nut yield kg/plant cumulative total for four years	Average of 4 years kg/plant
T1	17.9	3027.3	756.8	13.5	3.4
T2	20.4	4218.5	1054.6	19.2	4.8
T3	19.0	4064.5	1016.1	18.8	4.7
T4	17.7	3653.0	913.3	16.5	4.1
T5	16.6	2237.5	559.3	10.0	2.5
SEm(+)	0.3	-	81.14	-	0.35
C.D.(5%)	1.0	-	250.13	-	1.07

Table 4.4. Effect of urea + endosulfan on shelling percent, leaf N content and pest incidence at Bhubaneshwar centre.

Treatment	Shelling %	Leaf N before spraying	Leaf N after spraying	Tea mosquito damage	Shoot tip caterpillar
T1	30.4	1.7	1.6	10.6	10.0
T2	30.6	1.7	1.8	15.7	14.3
T3	30.6	1.7	1.8	18.3	16.1
T4	30.7	1.6	1.8	25.1	16.5
T5	30.3	1.6	1.5	8.6	10.0

followed by T3 (1672) which were statistically on par. The number of nuts was the lowest in the treatment T5 (758/tree) where the soil application of urea was substituted by 2% urea spray (Table 4.7).

Yield increased with increased concentration of urea spray (4%). The trees receiving T4 treatment recorded highest yield of 5.9 kg/tree compared to 5.6 kg in trees receiving T3 treatment. The incidence of TMB damages in shoots was the highest in the treatment T3 (2.4%) and lowest in T5 (1.7%). In the panicles the damage was severe in the treatment T3 (14.7%) and lowest (9.5%) in control (T1).

The increase in yield by supplementing urea as 4 and 3 percent foliar spray along with the normal soil application of fertilizer was higher, fetching a net profit of Rs. 39804 and Rs.37500/ha respectively than conventional soil application of fertilizers without urea spray (Rs.17718/ha) (Table 4.8).

West Coast:

Vengurla

The experiment was conducted from 1991 to 1994 at Vengurla. The pooled analysis of data indicated that 3 or 4% urea spray along with insecticide resulted in significantly higher yield of nuts over the control

Table 4.5. Effect of foliar application of urea alongwith insecticides on no. of flowering panicle/ sq.m. and no. of nuts/plant of cashew at Jhargram centre.

Treat-ments	No. of flowering panicle/sq.m.			Mean	No. of nuts/plant			Mean
	1992	1993	1994		1992	1993	1994	
T1	21.0	23.8	21.4	22.0	729	751	882	787.3
T2	24.8	31.2	30.8	28.9	1490	1631	1543	1554.6
T3	19.9	27.6	28.3	25.2	997	1133	1357	1162.3
T4	19.6	24.3	25.7	23.2	591	814	1142	849.0
T5	23.0	21.7	20.6	21.7	705	692	813	736.6
Mean	21.6	25.7	25.3		902.4	1004.2	1147.4	
		S.Em(±)	C.D. at 5%			S.Em(±)	C.D. at 5%	
Year(Y)		0.93	2.57			122.92	340.68	
Treatment(T)		1.20	3.32			158.69	439.81	
Y X T		2.08	5.76			274.87	761.79	

Table 4.6. Effect of foliar application of urea alongwith insecticides on shelling percentage of Cashew at Jhargram centre.

Treat-ments	Yield/plant (Kg.)			Mean	Shelling percentage (%)			Mean
	1992	1993	1994		1992	1993	1994	
T1	2.3	2.5	2.8	2.6	24.1	31.3	31.6	29.0
T2	4.9	5.9	6.1	5.6	38.2	36.6	36.2	37.0
T3	3.1	4.3	5.6	4.3	36.7	36.8	35.9	36.5
T4	2.1	2.9	4.5	3.2	33.5	32.2	34.5	33.4
T5	3.0	2.7	3.1	2.9	29.4	29.1	30.4	29.6
Mean	3.1	3.6	4.4		32.4	33.2	33.7	
		S.Em(±)	C.D. at 5%			S.Em(±)	C.D.at 5%	
Year (Y)		0.34	0.95			0.33	0.93	
Treatment (Y)		0.44	1.23			0.43	1.21	
Y X T		0.76	2.13			0.75	2.09	

Angular transformed values were used in analysis.

Table 4.7. Effect of foliar urea spray with endosulfan on flowering, nut yield, shelling percent, leaf N content and pest incidence at Vridhachalam Centre.

Treatment	No. of Flowering panicles nos./sq.m	No. of nuts/tree	Nut yield kg/tree	Shelling percent	Leaf N (%)	Leaf N (%)	Tea mosquito damage	
					before spraying	after spraying	Shoots	Panicles
T1	23.6	979	3.1	27.8	1.5	1.6	1.7	9.5
T2	24.6	1322	4.4	28.1	1.5	1.7	2.0	12.0
T3	29.9	1672	5.6	28.6	1.6	1.8	2.4	14.7
T4	31.0	1769	5.9	28.9	1.7	1.9	2.2	13.1
T5	20.6	758	2.5	27.4	1.1	1.0	1.7	10.6
SEm(±)	0.48	55.17	0.12	0.18	0.05	0.01	0.06	0.47
CD (0.05)	0.97	110.33	0.25	0.37	0.10	0.01	0.12	0.93

Table 4.8. Economic feasibility of foliar spray of urea at Vridhachalam centre.

Treat-ments	Expendi-ture (Rs.)	Yield/ kg/ha	Revenue Rs./ha	Net profit Rs./ha
T1	7050	619.2	24768	17718
T2	7140	883.0	35320	28180
T3	7180	1117.0	44680	37500
T4	7220	1175.6	47024	39804
T5	5900	500.4	20016	14116
Assumptions				
Cost of inputs				
Urea			Rs.3.60/kg	
Single super sulphate			Rs.3.35/kg	
Muriate of Potash			Rs.5.80/kg	
Endosulfan			Rs.150/litre	
Cost of labour			Rs.30/day	

(only NPK soil application) (Table 4.9).

The economics of urea spray is presented in Table 4.10 and expenditure on input utilised for increasing yield is presented in Table 4.11.

By spending additional Rs. 12.3 and

Table 4.9. Effect of foliar application of urea alongwith insecticidal spray on yield of nuts (Pooled data 1992-1994) at Vengurla centre.

Treat-ments	Yield of nuts kg/tree			Pooled mean
	1991-92	1992-93	1993-94	
T1	9.1	7.2	6.7	7.7
T2	12.4	8.3	5.0	8.6
T3	14.7	11.2	8.7	11.5
T4	16.5	11.9	9.9	12.7
T5	10.5	6.9	5.1	7.5
S.Em(±)	2.66	2.01	0.96	0.61
C.D. (5%)	N.S.	N.S.	3.13	1.99

Rs. 16.2 per tree for the treatment 3 per cent and 4 per cent urea spray the additional income received was Rs. 142.1 and Rs. 186.6 and per cent increase over control 46.4 per cent and 60.9 per cent respectively. The cost benefit ratio was 1:6.82 and 1:7.13 in respect of 3 and 4% urea spray respectively. The scorching of tender leaves were observed in 4% urea spray treatment.

Table 4.10. Economics of urea spray alongwith insecticide on cashew at Vengurla centre.

Sl. No.	Name of the treatment	Av. yield of nut/tree (1991-94)	Total Expenditure Rs.	Addl. Expenditure/ Treatment Rs.	Gross income cashew nut Rs.	Gross addl. income Rs.	Net addl. income Rs.	Percent increase on control	Cost benefit ratio
1	T1	7.7	55.2	-	306.4	-	-	-	1:5.55
2	T2	8.6	59.6	4.4	342.8	36.4	32.0	10.5	1:5.75
3	T3	11.5	67.5	12.3	460.8	154.4	142.1	46.4	1:6.82
4	T4	12.7	71.4	16.2 ¹⁴	509.2	202.8	186.6	60.9	1:7.13
5	T5	7.5	52.8	2.4	299.6	6.8	-	-	1:5.68

Table 4.11. Treatmentwise input expenditure (Rs./tree) at Vengurla centre.

Sl. No.	Item of expenditure	Control T-1	T-2	T-3	T-4	T-5
1.	Fertilizers	10.6	10.6	10.6	10.6	6.3
2.	Fertilizer application cost	7.0	7.0	7.0	7.0	7.0
3.	Cost of insecticides for three sprays	13.1	13.1	13.1	13.1	13.1
4.	Spraying charges	6.9	6.9	6.9	6.9	6.9
5.	Cost of urea	-	2.3	3.4	4.6	2.3
6.	Harvesting charges	17.6	19.7	26.5	29.3	17.2
	Total	55.2	59.6	67.5	71.5	52.8

(a) HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices and 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 at Bapatla (Andhra Pradesh), Vridhachalam (Tamil Nadu), Anakayam (Kerala) (later shifted to Madakkathara); Vengurla (Maharashtra) and CPCRI, Regional Station, Vittal (Karnataka). During the fifth plan period, one more Centre at Bhubaneswar (Orissa) and in Sixth Plan period two Centres one at Jhargram (West Bengal) and another at Chintamani (Karnataka) were added. During the VIII Plan period, a new Centre at Jagdalpur (Madhya Pradesh) under Indira Gandhi Krishi Vishwavidyalaya and a sub-centre at Pilicode (Kerala) were started.

The Project Coordinator's Cell was then located at Central Plantation Crops Research Institute, Kasaragod. During the Seventh Plan period, the Project was bifurcated into (1) All India Coordinated Cashew Improvement Project and (2) All India Coordinated Spices Improvement Project (vide ICAR office order F.No.4-1/80-H&MC dated 24 September 1985). The Project Coordinator's Cell has since then shifted to National Research Centre for Cashew, Puttur.

In all, there are eight functional coordinating centres and one sub-centre-four in the East coast, viz., Bapatla, Bhubaneswar, Jhargram, Vridhachalam, three in the West coast, viz., Madakkathara, Vengurla, Pilicode and one in the Maidan Parts of Karnataka-Chintamani and one in the Central India at

Jagdalpur.

The objective of the Project is to give additional thrust to cashew research for increasing production and productivity through:

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

The first Workshop of All India Coordinated Spices and Cashewnut Improvement Project was held at Kasaragod in October 1971 in which the research programmes were drawn up, identifying the problems and fixing the priorities. Subsequently, the progress of work was reviewed in the Workshops held in 1972 (Trivandrum, Kerala); 1975 (Coimbatore, Tamil Nadu); 1978 (Panjim, Goa); 1981 (Trichur, Kerala); 1983 (Calicut, Kerala); 1985 (Trivandrum, Kerala); 1987 (Bhubaneswar, Orissa); 1989 (Coimbatore, Tamil Nadu); 1991 National Group Discussion (in lieu of X Biennial Workshop) Kasaragod, Kerala; 1993 (Bangalore, Karnataka) and 1995 (Kasaragod, Kerala).

Two group discussions were also held one in horticulture and another in entomology during 1986 and 1988 at CPCRI, Regional Station, Vittal and Trichur, respectively.

The significant achievements of the Project are summarised below:

1. A total of 25 varieties are released by the various coordinating centres for cultivation in the respective regions.
2. Hybrid Dhana (H-1608) developed at Madakkathara showed wider adaptability across the East Coast (Orissa), West Coast (Maharashtra) and Maidan areas (Chintamani).
3. Fertilizer requirement of cashew crop was worked out to be 1000g N, 250g P_2O_5 and 250g K_2O per tree at Chintamani and Bhubaneswar centres and 500g N, 125g P_2O_5 and 125g K_2O per tree at Bapatla, Vengurla, Madakkathara and Vridhachalam centres.
4. Fertilizer application in circular trench of 25 cm broad, 50 cm depth and 1.5 cm 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 m and 3.0 m from the trunk and forking into the soil is found to be economical and the most efficient.
5. Supplementing the soil application of NPK with foliar application of urea (2%) along with insecticides increased the yield of cashew both at East Coast and West Coast centres.
6. Soft wood grafting technique was standardised for vegetative propagation of cashew.
7. Intercropping with perennials is dispensed with, instead annuals are being tried at all the Centres. Among annual intercrops pulses (horsegram), vegetables (cucurbits) were found to be profitable.
8. For control of TMB, spraying of monocrotophos (0.05%) at flushing, endosulfan (0.05%) at flowering and carbaryl (0.1%) at fruiting stage was found to be the most effective (Bapatla, Bhubaneswar, Jhargram and Vengurla).
9. Application of Sevidol 4G (75 g/tree) + swabbing the main stem and exposed roots with neem oil (5%) was an effective prophylactic control measure for stem and root borer.
10. Survey of pest collection at Bapatla centre revealed that cashew plantations at high altitudes of North coastal Andhra were prone to TMB infestation and apple and nut borer was prevalent in the south coastal regions.

(b) STAFF POSITION

At Headquarter :

Project Coordinator	Dr. E.V.V. Bhaskara Rao
Senior Scientist	Dr. M.G. Bhat (from 16-09-95)
Technical Information Officer	Miss. Uma Jayaraman
Stenographer	Mrs. B.Jayashri (from 02-06-95)

Project Centres

Cashew Research Station, Bapatla 522 101, (APAU), Andhra Pradesh

Horticulturist	Dr. M.Lakshmi Narayana Reddy (from 08-01-96)
	Dr. K.Pampapathy (till 30-11-95)
Asst. Entomologist	Mrs. M. Rama Devi (from 28-03-81)
Asst. Agronomist	Mr. Y.Radhakrishna (from 27-02-88)
Sr. Technical Assistant	Mr. B.Krishnamoorthy (from 09-10-95)
Jr. Technical Assistant	Mr. K. Ranga Rao (from 03-09-92)
Grafter	Vacant

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

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

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

Horticulturist (Agron.)	Dr. H.B. Lingaiah (from 16-05-94)
Jr. Horticulturist	Mr. Vishnu Vardhan (from 20-12-95)
Jr. Entomologist	Mr. G.T. Thirumalaraju
Sr. Technical Assistant	Mr. N.Jankiraman (from 21-06-95)
	Mr. Shivappa (from 15-02-95)
Grafter	Vacant

Zonal Agricultural Research Station, Jagadapur 494 005 (IGKV), Madhya Pradesh

Jr. Entomologist	Dr. Anuj Bhatnagar
Jr. Horticulturist	Dr. O.P. Awasthi
Jr. Technical Assistant	Vacant
Grafter	Vacant

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

Jr. Horticulturist	Dr. S.B. Chhattopadhyaya (from 06-01-96)
	Mr. J.K.Hore (till 31-12-95)
Jr. Entomologist	Dr.B.Bandopadhyay
Sr. Technical Assistant	Mr. S. Sarkar (from 05-04-95)
Jr. Technical Assistant	Mrs. K. Basu (from 27-04-95)
Grafter	Vacant

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

Horticulturist(Assoc. Professor -Agronomy)	Dr. M.Abdul Salam
Jr. Entomologist (Assistant Pro- fessor)	Dr.(Mrs.) Susamma Kurian (from 03-04-95)
Sr. Technical Assistant	Smt. B. Suma
Jr. Technical Assistant	Mr. C.Gireesan
Grafter	Mr. P.S. Ratnakumar

Cashew Research Substation, Pilicode (KAU), Kerala

Jr. Horticulturist	Dr.B.Jayaprakash Naik
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Regional Fruit Research Station, Vengurla 416 516 (KKV) Maharashtra

Horticulturist	Dr. D.P. Sawke
Jr. Entomologist	—
Jr. Breeder	Mr. S.B. Deshpande
Sr. Technical Assistant	Vacant
Jr. Technical Assistant	Mr. R.L. Mayekar

Regional Research Station, Vridhachalam 606 001 (TNAU), Tamilnadu

Horticulturist	Dr. M. Selvarajan
Jr. Horticulturist	V.Lakshmanan (from 29-02-96)
Jr. Entomologist	Mr. S.Douressamy
Sr. Technical Assistant	Mr.S.Manickam (from 01-01-96)
Jr. Technical Assistant	Mr.T.Chinnadurai
Grafter	P.Gopala Krishnan

(c) **BUDGETORY PROVISION AND ACTUAL EXPENDITURE DURING 1995-96**
ALLOCATION

(Rs. in lakhs)

Centre	Pay and allowances	TA	Recurring Contg.	Non-recurring Cont.	Total	ICAR Share
Bapatla	3.81	0.15	0.60	—	4.56	3.42
Bhubaneswar	2.85	0.15	0.60	0.85	4.45	3.34
Chintamani	2.77	0.15	0.60	—	3.52	2.64
Jagadapur	0.72	0.05	0.40	2.50	3.67	2.75
Jhargram	2.88	0.15	0.60	—	3.63	2.72
Madakkathara	2.90	0.15	0.60	—	3.65	2.74
Pilicode	0.70	—	—	—	0.70	0.52
Vengurla	2.73	0.15	0.60	—	3.48	2.61
Vridhachalam	3.00	0.15	0.60	—	3.75	2.81
Total	22.36	1.10	4.60	3.35	31.41	23.55

ACTUAL EXPENDITURE

Bapatla	4.59	0.12	0.60	0.58	5.89	4.42
Bhubaneswar	3.50	0.13	0.60	1.16	5.39	4.04
Chintamani	2.81	0.15	0.69	—	3.65	2.74
Jagadapur	—	0.06	0.40	0.47	0.93	0.70
Jhargram	2.45	0.06	0.28	—	2.79	2.09
Madakkathara	3.33	0.15	1.08	—	4.56	3.42
Pilicode	0.89	0.02	0.22	—	1.13	0.85
Vengurla	2.91	0.12	0.60	1.16	4.79	3.59
Vridhachalam	4.15	0.15	0.60	0.74	5.64	4.23
Total	24.63	0.96	5.07	4.11	34.77	26.08

(d) MONITORING OF PROJECT BY COORDINATOR

The programmes to be implemented in different centres was reviewed during the XII Biennial Workshop held at CPCRI Kasaragod during 14-16 October, 1995.

During the visit to the centres, the programme allotted to each of the centres and the progress made was reviewed along with inspection of field experiments. University authorities were met to appraise the progress of work in the centres, regularising the posts, removal of anomalies in filling up of posts and for sorting out the constraints of the centres if any.

During the visit to different states, also visited the Corporation/Departmental plantations regarding organising the development session in the Biennial Workshop, for identifying the constraints for production in plantations and imparted necessary technical advice/expertise to overcome the problems. During the visit to the centres, production and availability of grafts of the released varieties was reviewed and suggested means to increase the production of grafts.

Reports received from the Centres in the Project Coordinator's Cell were critically reviewed, a "Summary report" for the Workshop and "Proceedings of XII Biennial Workshop" giving therein guidelines for ongoing and new research experiments to each centre was prepared.

(e) FUNCTIONING OF EACH CENTRE

BAPATLA (APAU)

The centre was allotted germplasm col-

lection and maintenance, multilocation varietal evaluation trials and hybridisation and selection in Crop Improvement, nutritional experiments and intercropping with annuals in Crop Management. In Plant Protection, trials on foliage and inflorescence pests and survey for characterising the pest complex were undertaken.

At present 116 germplasm collections are being maintained in the conservation block at this centre. Germplasm evaluation reported from different locations indicated that the accessions collected from Guntur district and those collected from Vishakapatnam district (Simhachalam) were found to be superior under different agroclimatic conditions. In the varietal evaluation trial, only one Multilocation trial planted in December 1992 is in progress, MLT-86 was discontinued due to large number of gaps. In the hybrid evaluation trial, hybrids 4/1 and 3/10 were found to be promising.

Vegetative propagation trials and top working trial have been discontinued at the Centre as per the decisions of XII Biennial Workshop held in 1995. The response to the higher dose of nitrogen was recorded in the vegetative growth characters. In cropping system trials cluster bean and cowpea during the kharif were identified for cultivation.

On-farm trial using higher doses of fertilisers laid out in Andhra Pradesh Forest Development Corporation (APFDC) is in progress. With doubling the dosage of fertilizers, the yield increased from 8.5 kg to 11.2 kg per tree. High density planting using

clones of BPP-5 with 625 plants/ha to study the impact of close spacing on yield is in progress at the centre. In plant protection, trial on skipping the second spray at flowering stage indicated an enhancement of parasite activity on *Lamida monocusalis* upto fifty per cent. Swabbing of trees with neem oil (5%) was found to be the effective prophylactic measure against cashew stem and root borer. In the survey for the pest complex, tea mosquito infestation was recorded in South western districts and shoot and blossom webber in Southern districts of Andhra Pradesh. The spray schedule of monocrotophos, endosulfan and carbaryl was found to be the most effective.

The centre was granted Revolving Fund scheme of the Department of Horticulture for production of cashew grafts. During the year 16,621 cashew grafts were prepared and supplied to Cashew farmers of the State.

BHUBANESWAR (OUAT)

The Centre was given the responsibility of collecting cluster bearing types and bold nut types in the germplasm collection. Centre has assembled 84 accessions of which three were added (one bold nut type and two cluster bearing type) during the current year. In the evaluation of released varieties, BPP-1, Bhubaneshwar-1 (BBSR-1), BPP-4 were found to be promising. In Multilocation trial-86, H-2/16 continued to give maximum yield as in the last year. In MLT-92, type H-320 has given maximum yield followed by H-68 and H-302. In hybridization programme, the centre has made 4297 pollinations with the combinations of BBSR-1 x H 2/16, BBSR-1 x H-2/15 and BBSR-1 x VTH-711/4. Maximum number of 129 nuts were obtained in the hybrid (cross of BBSR-1 x H-2/15) but

the maximum success percentage (12.06%) was noted in the cross between BBSR cluster x VTH-711/4.

In Crop Management, higher doses of N,P and K and their combinations were found to be beneficial. The studies on foliar application of urea along with insecticides is concluded at the centre. A fresh trial using 625 plants/ha in high density planting with regular fertilizers is taken up. The studies on vegetative propagation and top working trials has been discontinued at the centre as per the decisions of the XII Biennial Workshop-1995. The centre has to initiate inbreeding programme in the screened root stocks for dwarfing characters by resorting to selfing. In Crop protection trial, application of monocrotophos at the rate of 0.05% at flushing stage was found to be effective in reducing shoot tip caterpillar infestation. The best treatment against TMB and inflorescence thrips (yellow thrips and black thrips) was found to be monocrotophos (0.05%) - endosulfan (0.05%) - carbaryl (0.1%). The centre has not taken up the skipping of second round of spray schedule in large plot trial. Swabbing of trees with neem oil (5%) along with the application of Sevidol (75g/tree) was found to be the effective prophylactic method against cashew stem and root borer. Leaf miner was found to be parasitised by *Sympiesis* sp. during November. Cashew types H-1600 and OC-11 had least infestation to shoot tip caterpillar. The centre has also been granted Revolving Fund Scheme by the Directorate of Cashewnut Development (DCD), Cochin for production of cashew grafts.

CHINTAMANI (UAS)

The centre was allotted with four experiments in Crop Improvement, one in

Crop Management and three in Crop Protection. The centre has a germplasm collection of 116 accessions. Among them four accessions were found to be high yielding (10 kg to 31 kg/tree). In comparative yield trial the maximum nut weight of 7.0 g was noticed in Vengurla-3. In MLT-I in M 44/3, H-1608, H-1598, H-1610, the yield was found to be more than 8 kg/tree.

Application of 1000g of nitrogen, 250g each of phosphorous and potassium per tree gave higher yields than the control. Vegetative propagation trial is discontinued at the Centre as per the decisions of the XII Biennial Workshop-1995.

A fresh trial on high density planting (625 plants/ha) with regular fertilizer application and two on-farm trials using the best planting material with higher doses of fertilizers is yet to be taken up by the centre. Plant protection experiments could not be carried out at the Centre as the entomologist was on deputation from 3 April 1995 to 2 April 1996.

In the experiment on Bioecology of pests of regional importance, the centre was to carry out correlation studies between major and minor pests of cashew, viz., tea mosquito, leaf miner, leaf and blossom webber, leaf thrips, inflorescence thrips, fruit and nut borer and weather parameters viz., maximum temperature, minimum temperature, mean temperature, maximum relative humidity, minimum relative humidity, mean relative humidity, rainfall and sunshine hours. A negative correlation was obtained between the pests and weather parameters studied at the Centre. Except in case of inflorescence thrips, fruit and nut

borer and tea mosquito incidence, an increase in incidence with increase in temperature was noticed.

The Revolving fund scheme was also sanctioned to this Centre by the Directorate of Cashewnut Development, Cochin.

JAGADALPUR (IGKVV)

The centre was started during 1993. The centre was desired to collect the germplasm from NRCC Puttur, Vengurla, Bapatla and Madakkathara. However, the centre is yet to establish germplasm plot. The centre has collected graft material from Vengurla and Vridhachalam for laying out multilocation variety evaluation trial but the mortality was very high. The fertilizer experiment was laid out in farmers' plot. The survey for pest complex was conducted in four different blocks viz., Bastar, Bukawand, Lohandiguda and Darbha and the intensity of pest incidence varied in different plots. Tea mosquito bug, aphids, leaf weevil and hairy caterpillar were recorded during the survey. The field trial was laid out on chemical control of TMB in the farmer's field.

As the centre is newly started in the current plan period, the work at the centre needs to be systematised. The amount of non-recurring contingencies for 1994-95 and 1995-96 were revalidated by the Council for 1996-97 and infrastructure facilities are expected to be developed in the next year.

JHARGRAM (BCKV)

The centre is allotted with three experiments each in Crop Improvement and Crop Protection and four experiments in Crop Protection. The centre has the germplasm

collection of 127 accessions of which two were added during the current year. These collections were made from Deepal and Hameerpur districts of Midnapore, West Bengal. In the MLT-86, VTH-59/2, VTH-30/4, H-2/16 and H-2/15 were found to be promising. In MLT-92, M 44/3 from Vridhachalam was found to be superior.

In spacing trial, the maximum yield per plant and yield per block was recorded in trees planted in 10m x 5m rectangular system with no thinning of plants and yield per block was maximum in 6m x 6m x 6m triangular system. The trials on vegetative propagation and top working are discontinued at the centre as per decisions of XII Biennial Workshop 1995.

In crop protection, spray schedule of monocrotophos-endosulfan-carbaryl was found to be the most effective. Spraying during flushing and flowering stages was found to be more economical. Application of neem oil (5%) to the tree trunk and Sevidol 4G (75g/tree) to the basin was found to be effective prophylactic control method against cashew stem and root borer. About 40 species of pests were recorded in cashew in different seasons during the survey. Leaf and blossom webber, leaf miner and thrips were found to be more severe pests than tea mosquito bug in West Bengal.

MADAKKATHARA (KAU)

The clonal germplasm block of the centre consists of 120 accessions. In hybrid evaluation trials, two hybrids viz., H-1591 and H-1597 were found to be promising. Hybrid-1591 was approved for release under the name Priyanka during the XII Biennial Workshop-1995.

In the multilocation evaluation trials M 26/2, M 44/3 from Vridhachalam and V-5 from Vengurla were found to be promising. In the screening for the dwarf root stocks, it is indicated that based on morphological characters, phenolic content in leaves, bark index and bark percentage, it is possible to identify the less vigorous types. In the hybridization programme 176 hybrid seedlings were field planted by using BLA-139-1, V-5 and exotic Panama accessions.

The centre was asked to take up high density planting with 625 trees/ha, a trial with higher doses of nitrogen and intercropping trial with medicinal and aromatic plants.

In crop protection, application of neem oil (5%) on the tree trunk and exposed roots along with application of Sevidol 4G (75g/tree) prevented infestation of cashew stem and root borer upto three months.

In the screening of germplasm for resistance to tea mosquito, four accessions viz., A-26-2, H-7/8, H-8-8 and H-3-17 were found to be comparatively tolerant to tea mosquito bug.

PILICODE (KAU)

The centre was started during 1994. The work of germplasm survey of northern districts of Kerala was given to this Centre. A total of 33 germplasm accessions is available, out of which eighteen accessions were collected from survey of Balal, Kilianthera, Iriya, Pilicode and Mandapam areas of Kasaragod and Kannur districts of Kerala. Seven accessions were bold nut types with kernel weight exceeding 2 g/nut.

VENGURLA (KKV)

In Crop Improvement collection of

germplasm, multilocation variety evaluation trials, hybridization and selection are in progress at the centre. In the germplasm collection, evaluation and maintenance the centre is entrusted with the responsibility of collecting bold nut types from Maharashtra and Goa.

Out of 161 accessions, 80 accessions have been evaluated and planted in the conservation block. The centre has collected 13 bold nut types from ICAR Research Complex Goa and five types were planted in the fields. Best yield for the reporting year was recorded to be 11.4 kg per tree in the accession no. 126/17/2 which was planted in 1980. In MLT-I trail, V-5 gave the highest yield (6.2 kg/tree) and the performance of H-1598, H-1608 was found to be superior.

In the hybridization programme, eight cross combinations involving V-2, V-5 and Hy 2/16 were crossed with bold nut types. The highest yield was recorded in hybrid 255 (V-3 × M 10/4) followed by hybrid 445 (M 10/4 × Vetore 56). The mean cumulative yield (past 10 years) was maximum in Hy. No.367 (10.5 kg). Hy.255 (V-3 × M 10/4) had the highest yield (18.5 kg) at 12th year (1995). Promising hybrids 255, 303, 320 and 367 have been included in MLT-II at the Centre. The trials on top working and vegetative propagation were discontinued as per the XII Biennial Workshop 1995. Seven year old top worked trees gave an average yield of 6.8 kg per tree and maximum yield of 9.4 kg/tree.

In the screening of root stock, sixteen accessions were characterised and field planted for further evaluation. In foliar application of urea (3%), along with insecticide spray schedule thrice is recommended

at the Centre. A new nutritional trial was planted in the year 1990 and so also the spacing trial. The yield data of nutritional trials is not reported by the Centre. The centre has produced 3.12 lakh of cashew grafts and supplied to the needy farmers.

In Crop Protection, the standard dose of pesticides was found to be the most effective in controlling TMB and other minor pests. Single spray of endosulfan (0.05%) at flowering stage was found to play an important role in TMB management as it was found to be at par with combinations of two sprays and scheduled three sprays.

In control of flower thrips second and third sprays together was found to be as effective as scheduled three sprays. Regarding the prophylactic control trials on stem and root borer, the observations were being recorded at the centre.

In the screening of germplasm to locate tolerance/resistance to the major pests of the region, five of the eighteen accessions screened were found to be tolerant. Least pest incidence was recorded in the accession CYT-195, H-26, J-1, Taliparamba and CYT-176. In the survey of pest complex the centre is yet to take up the correlation studies on the relationship of pests recorded and prevailing weather parameters.

VRIDHACHALAM (TNAU)

The centre has assembled 255 accessions in the germplasm project. During the year 130 accessions were multiplied and planted in the conservation block. Evaluation of germplasm has indicated superiority of collections made from North and South Arcot districts. In the germplasm evaluation

M 33/3 gave the highest yield, type NR-51 gave the bold nuts with 8.82g and M3/2 had the highest shelling percentage of 32.6 per cent.

In the Multilocation variety evaluation trial, M 44/3 (VRI-2), M 26/2 (VRI-3) and M 33/3 were found to be vigorous. In the MLT-92, out of thirteen entries M 15/4 was found to be promising. In the hybrid evaluation trials, Hybrid 16 (M 44/3 x M 75/3) and Hybrid 17 (M 44/3 x M 45/4) gave the highest yield whereas Hybrid 13 (M 26/2 x M26/1) gave the highest yield for the last six years.

NPK fertilizer experiment is laid down afresh in the New Block of the centre. Foliar spray of three per cent and four per cent urea with endosulfan along with the soil application of N,P and K (500g, 250g and 250g/tree) was found to be the best in terms of yield and profits.

In the intercropping trials, blackgram was found to be the most profitable intercrop without affecting the growth of the main crop cashew. Intercropping with oil seeds is proposed to be taken up during ensuing monsoon. The trials on vegetative

(f) PROBLEMS IN FUNCTIONING OF THE CENTRES

Bhubaneswar

At Bhubaneswar centre as there is no boundary around the farm, cattle menace is encountered; there is no irrigation facility during lean months; irrigation source for nursery programme is inadequate.

Jagadapur

At Jagadapur centre, sanctioned posts

propagation and top working were discontinued at the centre as per the decisions of the XII Biennial Workshop-1995.

In commercial production of cashew grafts under cashew Regional Nursery programme, 15,000 grafts were produced by soft wood grafting technique. A few trees of VRI-1 is proposed to be top worked with VRI-3 scions during July-November 1996. The trial on high density planting (625 plants/ha) and on-farm trial with higher dose of nitrogen is yet to be initiated at the centre.

Trials on crop protection are being pursued at the centre. A trial on prophylactic control on stem and root borer is laid down at State horticultural farm, Neyveli.

In the survey of pest and correlation studies, maximum tea mosquito incidence was noticed during the summer season and rainy season thereby revealing a positive correlation with incidence of TMB and temperature and rainfall. Among the natural enemies, spiders were noticed throughout the year. In the screening of germplasm to locate tolerant/resistant types, none of the F₁ entries were found to be tolerant/resistant, and so also the MLT entries.

are yet to be filled; the survey of insects/pests could not be undertaken due to lack of funds/vehicle in entire Bastar district; Experiments on crop improvement and crop management aspects could not be undertaken due to lack of grafted orchards of cashew on farmers field in the vicinity of Research Station.

(g) METEOROLOGICAL DATA (1995-96)

BAPATLA

Month & Year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Apr. 1995	33.7	24.6	76.0	70.0	0.0	—
May. 1995	34.3	25.0	75.0	68.0	192.3	5
Jun. 1995	36.7	27.9	64.0	57.0	26.7	1
Jul. 1995	33.2	25.1	80.1	68.0	120.8	10
Aug. 1995	34.0	25.7	80.0	69.0	265.1	13
Sep. 1995	33.0	25.5	81.0	73.0	89.8	8
Oct. 1995	31.0	24.9	88.3	85.7	195.5	11
Nov. 1995	31.5	21.7	85.9	71.3	11.3	1
Dec. 1995	29.9	17.8	89.5	61.1	0.0	—
Jan. 1996	29.9	17.1	94.1	65.0	0.0	—
Feb. 1996	30.5	18.8	87.0	65.0	0.0	—
Mar. 1996	32.7	21.1	83.5	66.0	0.0	—

BHUBANESWAR

Month & Year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Apr. 1995	37.4	24.9	89.0	48.0	11.4	2
May. 1995	34.6	26.3	91.0	65.0	703.9	9
Jun. 1995	34.2	26.7	89.0	72.0	132.2	13
Jul. 1995	31.8	25.8	93.0	77.0	176.4	16
Aug. 1995	32.4	25.7	93.0	77.0	195.1	22
Sep. 1995	31.9	25.5	93.0	75.0	240.2	17
Oct. 1995	30.5	23.5	93.0	75.0	335.0	19
Nov. 1995	29.2	19.0	90.0	58.0	183.5	7
Dec. 1995	28.9	14.7	92.0	44.0	0.0	—
Jan. 1996	29.1	16.9	93.0	51.0	83.5	2
Feb. 1996	30.9	18.3	95.0	46.0	4.6	2
Mar. 1996	35.0	22.6	92.0	47.0	0.0	—

CHINTAMANI

Month & year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan. 95	27.4	15.3	77.8	49.7	0.0	—
Feb. 95	31.0	15.3	76.4	46.3	0.0	—
Mar. 95	32.9	16.5	61.3	39.9	8.4	1
Apr. 95	34.4	21.3	73.9	38.4	0.0	—
May. 95	33.3	21.2	73.0	43.5	163.3	7
Jun. 95	30.6	20.6	73.7	50.1	85.8	8
Jul. 95	29.1	19.4	80.0	60.2	122.6	9
Aug. 95	29.4	19.9	82.1	63.2	194.8	8
Sep. 95	29.5	19.3	78.1	58.8	163.8	5
Oct. 95	29.3	18.1	74.3	62.2	133.5	9
Nov. 95	29.1	16.4	75.2	58.3	22.2	3
Dec. 95	27.1	11.5	64.2	51.5	0.0	—

JAGDALPUR

Month & year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan. 95	24.8	09.6	93.0	43.0	54.1	3
Feb. 95	30.0	12.7	89.0	24.0	0.0	—
Mar. 95	33.5	16.3	75.0	27.0	21.3	2
Apr. 95	36.2	21.4	67.0	28.0	72.2	4
May. 95	33.6	22.8	81.0	43.0	85.8	6
Jun. 95	34.5	24.9	77.0	51.0	171.3	4
Jul. 95	28.4	24.9	89.0	74.0	459.1	17
Aug. 95	28.9	24.4	91.0	72.0	276.9	14
Sep. 95	29.1	23.5	91.0	64.0	197.0	9
Oct. 95	29.1	21.5	92.0	58.0	107.5	5
Nov. 95	27.7	16.4	92.0	39.0	0.0	—
Dec. 95	27.8	13.2	94.0	24.0	0.0	—

JHARGRAM

Month & year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Apr. 95	38.0	18.3	84.6	44.6	21.6	2
May. 95	39.4	21.2	84.2	46.6	154.4	9
Jun. 95	39.5	22.6	89.4	64.3	201.2	11
Jul. 95	35.8	24.5	90.0	72.1	309.2	16
Aug. 95	35.0	22.8	90.2	75.2	333.0	19
Sep. 95	34.6	21.3	89.8	70.4	292.6	17
Oct. 95	32.5	22.4	88.2	67.1	90.4	7
Nov. 95	29.2	12.1	82.5	48.9	158.0	5
Dec. 95	25.9	10.1	81.4	44.3	0.0	—
Jan. 96	26.2	8.6	80.2	40.5	33.8	3
Feb. 96	28.3	15.3	78.0	44.3	10.0	2
Mar. 96	35.2	19.1	79.5	34.6	13.4	2

MADAKKATHARA

Month & year	Temperature (°C)		Relative humidity % (mean)	Rainfall (mm)	No. of rainy days
	Maximum	Minimum			
Apr. 95	36.6	24.9	71.0	118.7	5
May. 95	33.5	23.9	78.0	370.5	13
Jun. 95	31.6	23.1	86.0	500.4	19
Jul. 95	29.9	23.2	89.0	884.7	26
Aug. 95	30.6	23.7	86.0	448.7	22
Sep. 95	30.1	23.5	82.0	282.5	13
Oct. 95	33.2	23.2	78.0	110.4	8
Nov. 95	31.3	22.5	80.0	88.4	5
Dec. 95	32.5	21.3	57.0	0.0	—
Jan. 96	33.1	22.4	53.0	0.0	—
Feb. 96	34.7	23.4	53.0	0.0	—

PILICODE

Month & year	Temperature (°C)		Relative humidity % (mean)	Rainfall (mm)	No. of rainy days
	Maximum	Minimum			
Apr. 95	33.4	25.6	81.6	60.0	32.2
May. 95	32.8	25.4	87.5	67.9	150.0
Jun. 95	30.1	26.9	94.5	80.7	907.2
Jul. 95	27.8	23.5	99.2	91.4	1172.8
Aug. 95	28.9	24.8	98.5	85.3	543.9
Sep. 95	29.5	24.5	97.1	78.6	202.1
Oct. 95	30.7	23.8	97.9	72.4	174.8
Nov. 95	31.0	22.8	93.3	71.0	68.7
Dec. 95	31.3	18.7	91.7	49.7	0.0
Jan.96	31.3	18.7	89.7	51.5	0.0
Feb. 96	32.2	20.8	89.7	52.3	0.0
Mar. 96	33.0	24.1	91.0	63.4	0.0

VENGURLA

Month & year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Apr. 1995	32.8	23.1	72.3	60.5	0.0	—
May. 1995	33.9	25.7	67.4	62.8	16.0	4
Jun. 1995	31.6	24.9	84.8	79.5	899.2	21
Jul. 1995	29.9	24.3	86.3	86.0	1211.4	28
Aug. 1995	30.0	24.2	88.6	82.0	1389.4	23
Sep. 1995	31.0	23.8	87.0	78.0	106.8	11
Oct. 1995	25.6	22.9	85.0	72.0	172.8	11
Nov. 1995	32.9	19.1	78.0	62.5	0.0	—
Dec. 1995	32.9	16.4	74.8	52.8	0.0	—
Jan. 1996	31.4	17.1	81.3	52.8	0.0	—
Feb. 1996	32.4	17.2	77.5	52.5	0.0	—
Mar. 1996	31.9	21.1	81.6	62.8	0.0	—

VRIDHACHALAM

Month & year	Temperature (°C)		Relative humidity %		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Apr. 95	39.7	26.0	75.0	45.0	1.0	—
May. 95	42.2	27.0	73.0	45.0	170.4	4
Jun. 95	42.1	27.1	75.0	46.0	49.5	2
Jul. 95	39.0	24.5	76.0	41.0	42.7	2
Aug. 95	39.2	24.5	78.0	58.0	36.5	1
Sep. 95	37.9	24.2	77.0	73.0	212.4	8
Oct. 95	35.5	23.1	85.0	74.0	234.0	6
Nov. 95	33.5	23.2	88.0	72.0	104.3	4
Dec. 95	32.5	24.2	80.0	65.0	—	—
Jan. 96	30.5	20.1	84.0	71.0	—	—
Feb. 96	32.5	17.5	85.0	60.0	—	—
Mar. 96	36.0	20.5	83.0	61.0	—	—

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