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COORDINATOR'S REPORT

The All India Coordinated Spices and Cashewnut Improvement Project (AICS & CIP) was started during the IV Five Year Plan in 1971 with its headquarters located at the Central Plantation Crops Research Institute, Kasaragod.

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

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

The budget allocation of the project for the year 1998-99 was Rs. 53.33 lakhs (Rs. 40.00 lakhs ICAR Share) and the expenditure was Rs. 52.73 lakhs (Rs. 39.55 lakhs ICAR Share).

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

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

CROP IMPROVEMENT

During the year 45 germplasm accessions were added to the existing 1018. The Centre wise germplasm holdings are - Bapatla - 127; Bhubaneswar - 89; Jhargram - 118; Vridhachalam - 261; Madakkathara - 127; Pilicode - 64; Vengurle - 161; Chintamani - 106 and Jagdalpur - 10. This brings the collection of germplasm at various Centres of AICRP on Cashew to 1063. Among the germplasm accessions, M 44/3 at Bapatla, H 2/16 at Bhubaneswar, NRCC-1 at Chintamani and JGM 74/6 at Jagdalpur were found promising. Among the germplasm accessions at Bhubaneswar OC-22 with an average yield of 3.8 kg performed better. 2/6 ARSC at Chintamani performed well with a yield of 10.25 kg per tree. JGM 17/1 has yielded a highest of 12.57 kg/tree during the year at Jhargram. Brazil 248 with 6.1 kg at Madakkathara, 126/17/2

with an yield of 11.40 kg/tree and M 15/4 with an yield of 1.2 kg/tree at Vridhachalam were the highest yielders in each centre.

At Chintamani, the variety Vengurla - 5 that yielded 3.78 kg per tree that was highest under comparative yield trial. In Multi-location trial 86 (MLT 86) at Bhubaneswar and Jhargram H 2/16 from Bapatla yielded the highest of 17.10 kg/tree and 7.28 kg/tree respectively. Per tree yield was highest in M 44/3 with 4.60 kg at Jhargram, M 26/2 with a yield of 12.88 kg at Madakkathara and 7.10 kg for Vengurla-5 at Vengurle were the better performing varieties. In MLT 92, H 320 yielded better with 12.00 kg/tree at Bapatla. At Bhubaneswar, 30/1 yielded maximum (8.00 kg/tree). At Chintamani, VTH 107/3 yielded 5.5kg/tree which was highest in the centre. M 15/4 at Madakkathara yielded highest and M 44/3 yielded a maximum (2.4 kg/tree) at Vridhachalam.

Hybridisation was carried out in different stations by using high yielding local genotypes and other varieties. At Bapatla, 149 F1 seedlings were produced during the year. Bhubaneswar could achieve up to 14.4% success in crossing in BBSR-1 x VTH 711/4. At Chintamani, 26 different F1 hybrid trees got established. At Madakkathara yield of BLA-139/1 X P-3/2 was maximum (450 g) in first harvest. At Vengurle 170 nuts were obtained from different crosses. At Vridhachalam, M 44/3 x M 45/4 yielded highest of 3.5 kg/tree during the year. The grafts of F1 hybrids were being produced at various centres for the

vegetative propagation of hybrid planting material.

CROP MANAGEMENT

A. AGRONOMY

Doses of nitrogen upto 500g increased yield by increased number of flowering laterals sq. m⁻¹ and number of nuts per panicle. 1000g N : 250g P : 250g K was found to be a good fertilizer recommendation at Chintamani and Bhubaneswar. Cowpea inter-crop was found enterprising as mixed crop in cashew plantations at Bhubaneswar and Jhargram and groundnut was found profitable at Vridhachalam.

The preliminary results on the density of planting per unit area at Jhargram, which has given maximum yield per block was obtained in 6 x 6 x 6 m triangular planting whereas 5 m x 5 m was found to be yielding highest at Vengurle. However, these results may have to be continued further to obtain appreciable results. Cowpea inter-crop was found enterprising as mixed crop in cashew plantations at Bhubaneswar and Jhargram while groundnut was found profitable at Vridhachalam. Bitter gourd was found to be highest yielding inter crop at Vengurle.

B. HORTICULTURE

Six dwarf types at Bapatla, one semi dwarf at Bhubaneswar, 10 less vigorous and five vigorous types at Madakkathara and 15 types at Vengurle were under evaluation during the current year.

CROP PROTECTION

The recommended spraying of monocrotophos 0.05%, endosulfan 0.05%

and carbaryl 0.1% at flushing, flowering and fruiting stages respectively reduced percentage of insect infestation at all the centres. Soil application of Sevidol 8 G per tree and swabbing the trunk at meter height and exposed roots with oil 5% was found to be good prophylactic measure for the control of attack by cashew stem and root borer (CSRB) for a period of 120 days. At Vridhachalam, treatment with coal tar and kerosene 1:2 was found to be an effective method for control of CSRB. M 25/2 x M 75/3 showed low tea mosquito bug (TMB) damage in the centre.

In general, in most of the Centres the yield in early and mid bearing varieties was normal whereas, it was affected in late bearing ones due to climatic influence this year.

TRANSFER OF TECHNOLOGY

A total of 2,33,261 high yielding cashew grafts were produced at various centres and 2,06,161 were distributed to farmers and Govt. Agencies during the year. More than 170 Demonstration Plots in different states are being maintained by various centres under AICRP on cashew.

CENTRES OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW



- ◆ NATIONAL RESEARCH CENTRE FOR CASHEW, PUTTUR 574 202 - HEADQUARTERS OF AICRP ON CASHEW.
- 1. CASHEW RESEARCH STATION, (ANGRAU), BAPATLA 522 101, ANDHRA PRADESH.
- 2. CASHEW RESEARCH STATION, (OUAT), BHUBANESWAR 751 003, ORISSA.
- 3. AGRICULTURAL RESEARCH STATION, (UAS), CHINTAMANI 563 125, KARNATAKA.
- 4. ZONAL AGRICULTURAL RESEARCH STATION, (IGAU), JAGDALPUR 494 005, MADHYA PRADESH.
- 5. REGIONAL RESEARCH STATION, (BCKV), JHARGRAM 721 507, WEST BENGAL.
- 6. (a) CASHEW RESEARCH STATION, (KAU), MADAKKATHARA 680 656, KERALA.
(b) REGIONAL AGRICULTURAL RESEARCH STATION, (KAU), PILICODE 671 353, KERALA.
- 7. REGIONAL FRUIT RESEARCH STATION, (KKV), VENGURLE 416 516, MAHARASHTRA.
- 8. REGIONAL RESEARCH STATION, (TNAU), VRIDHACHALAM 606 001, TAMILNADU.

GENERAL CHARACTERISTICS OF CENTRES OF AICRP ON CASHEW

The eight coordinating centres and one sub centre are spread in the East Coast, West Coast and Maidan tracts of the country. The centres in the East Coast are located at Bapatla, Bhubaneswar, Jhargram and Vridhachalam. This zone receives low to medium rainfall ranging from 800 mm to 2000 mm annually and is distributed over a period of 7-8 months from June to January. The soil is mainly sandy, red sandy loam, red loam and laterite. The

centres in the West Coast are located at Madakkathara, Pilicode and Vengurle. This zone receives rainfall ranging from 2800 mm to 3800 mm annually and is distributed over a period of 7-9 months from April/ June to December. The soil is typically sandy, sandy loam, sandy clay loam and laterite (Oxisol). Maidan tract is characterised by even land. The coordinating centres Chintamani and Jagdalpur fall in this region.

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

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast : Madakkathara, Pilicode and Vengurle

Maidan tracts/ others : Chintamani and Jagdalpur

The highlights of achievements of the project are conservation of 1063 germplasm accessions collected so far out of which 45 collections belong to this year. Among the germplasm accessions at Bhubaneswar OC-22 with an average yield of 3.8 kg performed better. 2/6 ARSC at Chintamani performed well with a yield of 10.25 kg per tree. JGM 17/1 has yielded a highest of 12.57 kg/tree during the year at Jhargram. Brazil 248 with 6.1 kg at Madakkathara, 126/17/2 with an yield of 11.40 kg/tree and M 15/4 with an yield of 1.2 kg/tree at Vridhachalam were the highest yielders in each centre.

The objectives of the project are:

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

1. Germplasm collection and conservation :

A total of 1018 accessions has been conserved and is being maintained in different centres. During the year 1998, 45 collections were made by different

centres, of which 36 have already been planted (Table 1.1). The details of source of collection, number of collections and salient features of collections are presented in Table 1.2.

Table 1.1: Cashew germplasm holding in different centres.

Centre	No. of accessions		
	Existing	Collected during 1998	Total
East Coast			
Bapatla	125	2	127
Bhubaneswar	86	3	89
Jhargram	116	2	118
Vridhachalam	255	6*	261
West Coast			
Madakkathara	127	--	127
Pilicode	36	28	64
Vengurle	161	--	161
Maidan tract/others			
Chintamani	102	4	106
Jagdapur	10	--	10
Total	1018	45	1063

* Clones to be planted.

At Bapatla centre, two high yielding cashew genotypes have been collected from Andhra Pradesh Forest Development Corporation (APFDC), Kavali. The clonal material was multiplied in the nursery. Varieties from Ullal, Chintamani, Jhargram, Madakkathara and Anakkayam were also collected and field planted.

2. Germplasm evaluation:

Evaluation of cashew germplasm at

different centres has been carried out during the year 1998. The promising accessions in different centres are presented in Table 1.3 - 1.9.

At Bhubaneswar, 86 accessions were evaluated, of which, twenty accessions were promising (Table 1.3). The annual yield of accessions ranged from 0.1 - 4.1kg/plant.

Table 1.3: Performance of promising germplasm accessions at Bhubaneswar.

Accessions	Girth of tree trunk (cm)	Tree height (m)	Tree spread (m)		Average annual yield (kg/tree)
			E-W	N-S	
OC-1	54.6	4.4	5.6	6.4	1.6
OC-2	53.0	4.2	4.7	5.5	1.2
OC-3	68.5	5.9	8.4	6.8	1.6
OC-4	52.5	4.3	6.3	6.3	1.5
OC-6	53.0	4.5	6.3	6.0	1.9
OC-7	58.3	5.4	6.1	6.5	1.0
OC-12	64.0	5.0	5.9	6.8	1.6
OC-13	58.0	5.4	4.6	5.0	1.1
OC-15	55.5	4.6	6.3	6.0	1.8
OC-17	49.0	5.0	5.6	5.5	1.1
OC-21	48.0	4.2	4.7	5.4	1.1
OC-22	56.0	4.7	6.9	5.3	3.8
OC-23	65.0	5.9	6.2	6.5	1.2
OC-25	53.5	4.6	5.8	5.8	1.0
OC-27	36.0	3.6	4.3	3.6	1.0
OC-31	73.6	5.1	6.8	7.5	4.1
OC-46	55.0	4.5	5.6	5.0	2.4
OC-51	53.7	4.7	6.8	5.9	1.2
OC-87	54.7	5.1	6.6	5.7	1.0
OC-88	60.0	5.4	5.1	7.7	2.9

At Chintamani centre, 84 accessions were evaluated of which, five accessions were found to be promising (Table 1.4). The cumulative yield of 10-14 harvests

ranged from 53.60-113.57 kg/plant, weight/nut ranged from 4.21-7.02g and shelling percentage ranged from 28.3-31.0 per cent.

Table - 1.4: Performance of promising germplasm accessions at Chintamani.

Accession Number	Year of planting	Cumulative Yield (kg)	Annual Yield (kg/tree)	Mean nut yield (kg)	Mean nut weight (g)	Shelling %
2/6 ARSC (3/108 Gubbi)	1982	113.57	10.25	8.11	4.21	28.3
7/8 ARSC (2/77 Tuni)	1982	82.25	2.40	5.87	6.43	30.2
35/1 ARSC (ME 4/4)	1984	79.25	7.92	6.60	6.95	31.0
41/3 ARSC (5/37 Manjeri)	1985	109.59	3.50	9.96	7.02	29.5
44/8 ARSC (H-19)	1986	53.60	1.20	5.36	6.53	29.0

At Jagdalpur, maximum survival was recorded in NRC-130 followed by NRC-193. Maximum plant height was

recorded in NRC-138 and NRC-192 followed by NRC-136 (Table 1.5).

Table - 1.5: Evaluation of germplasm in Jagdalpur

Variety	Survival %	Pl. Height (cm)	Stem girth (cm)	No. of primary branches	Plant spread	
					N-S	E-W
NRC 130	66.6	123.3	22.1	3.5	256.8	216.9
NRC 131	72.2	136.8	19.2	3.3	179.7	170.1
NRC 136	33.3	133.3	21.1	3.7	168.3	188.9
NRC 137	61.1	152.5	22.9	4.0	183.1	180.5
NRC 138	44.4	180.6	21.6	3.6	243.7	221.3
NRC 140	66.7	22.5	20.1	3.6	175.0	176.3
NRC 190	33.3	98.3	12.9	3.7	109.4	117.2
NRC 191	55.6	122.5	17.9	3.8	171.6	177.2
NRC 192	66.7	142.7	19.3	3.6	181.6	167.2
NRC 193	77.8	106.2	17.5	3.2	148.3	149.8

At Jhargram centre, fifteen accessions were found to be promising (Table 1.6). The cumulative yield of ten harvests ranged from 46.13 - 91.37 kg/plant, nut weight ranged from 4.8 - 6.2g and shelling percentage ranged from 29.3 - 33.3 per cent. JGM 74/6

recorded the highest yield of 13.86 kg raw nut per tree during the year 1998 with highest cumulative yield of 91.37 kg nut over a period of 10 years. Shelling percentage in JGM 10/3 was maximum (33.3%).

At Madakkathara centre, thirty

accessions which were planted during 1988-89 were found to be promising (Table 1.7). The cumulative yield of six harvests ranged from 1.0 - 16.2 kg/plant and nut weight ranged from 4.51 - 12.60g in these accessions. Among 17 varieties planted during 1988, Brazil - 248 gave the highest yield (6.1 kg/tree) followed by

NDR 2-1 (5.7 kg) and Anakkayam - 1 (5.6 Kg/tree) during 97-98. Of the 39 varieties planted during 1989, H 1591 gave the highest yield (5.9 Kg/tree) followed by H-8-1 (5.7 Kg/tree) during 97-98. H 1588 (10.79g), H 1591 (12.6g), H-8-6 (10g), H 8-8 (12.3g), were the varieties which had the nut weight above 10g.

Table - 1.6: Performance of promising germplasm accessions at Jhargram.

Accession	Cumulative yield 11 harvests (kg/tree)	Annual yield (1998) kg/tree	Mean nut weight (g)	Shelling %
JGM 1/4	65.84	11.43	5.7	31.2
JGM 10/4	53.16	9.27	4.8	33.3
JGM 11	46.13	9.01	5.8	32.0
JGM 16/1	77.12	12.18	5.4	33.2
JGM 17/1	69.11	12.57	5.6	31.6
JGM 19/1	73.76	10.32	5.0	30.5
JGM 20/6	72.13	9.87	5.3	32.3
JGM 29/8	61.20	9.81	6.0	32.2
JGM 31/1	62.51	11.38	6.4	30.3
JGM 48/4	72.14	10.32	5.2	32.2
JGM 58/12	59.73	12.98	6.2	30.6
JGM 66/7	85.10	13.27	4.9	29.4
JGM 74/6	91.37	13.86	5.8	29.3
JGM 79/5	76.50	8.85	5.3	32.6
JGM 80/2	89.36	13.15	4.8	33.2

Performance of promising germplasm accessions at Madakkathara.

Accession No.	Year of Planting	Nut weight (g)	Annual Yield (kg/tree)	Cumulative yield (kg/tree) 6 harvests
Brazil-120	1988	7.6	4.10	9.30
Brazil-248 (m)	1988	7.4	3.00	5.70
Brazil-248	1988	7.0	6.10	11.70
KTR - 27	1988	7.0	3.50	8.30
Vapala	1988	8.0	3.60	10.07
Anakkayam-1	1988	6.6	5.60	16.20
BLA-39/4	1988	5.3	4.70	11.40
K-22/1	1988	7.2	3.70	7.30
NDR - 2/1	1988	9.0	5.70	11.00
H-3-13	1988	5.8	3.10	8.60
H-3/17	1988	6.4	5.20	9.60
H-680	1989	5.4	2.20	5.30
H-856	1989	9.1	3.50	6.00
H-1588	1989	10.8	4.00	7.70
H-1589	1989	9.2	3.50	10.30
H-1591	1989	12.6	5.90	9.70
H-1593	1989	8.4	5.10	11.30
H-1596	1989	6.4	5.30	10.20
H-1597	1989	8.4	3.70	7.80
H-1598	1989	8.4	4.40	10.40
H-1600	1989	6.4	3.70	9.00
H-1602	1989	7.0	3.40	7.00
H-1608	1989	8.6	2.60	7.00
H-1610	1989	8.0	3.60	7.70
M 1/2	1989	--	2.20	5.80
K-10-1	1989	8.4	3.60	5.40
K-19-1	1989	7.8	3.30	6.30
H-3-9	1989	7.6	2.80	9.70
H-7-6	1989	7.5	2.90	8.90
H-8-1	1989	8.2	5.70	8.30
H-8-6	1989	10.0	3.30	5.60

At Vengurle centre, 80 accessions were evaluated, of which, eleven accessions were found to be promising (Table 1.8). The cumulative yield of

eight harvests ranged from 44.36 - 79.61 kg/plant, nut weight ranged from 3.10 - 11.40g and shelling percentage ranged from 21.0 - 30.72 per cent.

Table - 1.8: Performance of promising germplasm accessions at Vengurle.

Accession No.	Year of Planting	Cumulative yield for 8 harvests (kg/tree)	Annual yield (kg/tree)	Mean nut weight (g)	Shelling %
80/02/4	1977	57.96	5.00	5.2	27.25
83/05/3	1977	63.81	4.70	6.1	27.65
87/09/2	1977	45.12	3.25	5.3	24.85
89/12/3	1977	73.83	5.07	5.3	30.72
94/17/5	1977	79.61	6.15	7.1	23.00
95/11/3	1977	44.36	3.60	6.7	23.00
96/11/5	1977	45.34	9.13	5.5	22.00
98/12/4	1977	72.92	6.28	6.3	21.00
109/22/2	1979	46.32	3.10	5.0	25.00
124/15/3	1979	54.35	5.85	6.8	29.55
126/17/2	1980	61.95	11.40	6.0	28.49

At Vridhachalam centre, out of the 130 accessions evaluated, three accessions were found to be promising (Table 1.9). The nut weight ranged from

5.79 - 7.01g and shelling percentage ranged from 27.0 - 30.5 per cent in these accessions.

Table - 1.9: Performance of promising germplasm accessions at Vridhachalam

Accession No.	Annual Yield (kg/tree)	Mean nut weight (g)	Shelling %
New Germplasm collection planted in 1994			
M 100/1	0.54	5.8	30.5
M 30/1	0.64	6.8	27.0
M 70/1	0.60	7.0	29.5
Old germplasm collection planted in 1989			
M 10/3	0.95	7.6	25.9
M 11/2	0.78	6.7	30.1
A 16/1	0.65	4.6	30.6
G 182	0.55	4.4	25.1
M 59/2	0.59	5.2	29.1
M 26/1	0.51	4.5	30.8
M 1/3	0.57	6.5	28.9
AF 150	0.78	6.1	27.6
M 103/3	0.78	6.0	28.3
M 33/3	1.00	7.7	26.6
M 15/4	1.20	6.3	29.0

Project Title : Gen.3 : Varietal evaluation

Three varietal evaluation trials are in progress at 8 different centres.

The highlights of the project at Chintamani indicate the variety Vengurla - 5 that yielded 3.78 kg per tree under comparative yield trial was the better yielder. In MLT 86 at Bhubaneswar and Jhargram H 2/16 from Bapatla yielded the highest of 17.10 kg/tree and 7.28 kg/tree respectively. Per tree yield was highest in M 44/3 with 4.60 kg at Jhargram, M 26/2 with a yield of 12.88 kg at Madakkathara and 7.10 kg for Vengurla-5 at Vengurle were the better performing varieties.

In MLT 92, H 320 yielded better with 12.00 kg/tree at Bapatla. 30/1 yielded maximum (8.00 kg/tree) at Bhubaneswar. At Chintamani VTH 107/3 yielded 5.5kg/tree which was highest in the centre. M 15/4 at Madakkathara yielded the best and M 44/3 yielded the highest (2.4 kg/tree) at Vridhachalam.

Expt. 1 : Comparative yield trials

Centre : Chintamani

The objectives are to evaluate the performance of varieties of Bapatla and Vengurle.

Design	: RBD
Replication	: Three
Varieties	: No. of entries: 10
Bapatla entries	: Bapatla-1, Bapatla-3, Bapatla-4, Bapatla-5, and Bapatla-6.
Vengurle entries	: Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, and Vengurla-5.
Year of planting	: 1986

The performance of the varieties for different characters is presented in Table 1.10.

Table 1.10 : Growth and yield performance of varieties at Chintamani under comparative yield trial.

Variety	Height (m)	Girth (cm)	Canopy shape	Flowering period	Nut yield (kg)	Cumulative yield for 9 harvests	Nut weight (g)	Shelling (%)
Vengurla-1	5.9	87.9	Compact	Medium	2.55	30.13	5.2	28.5
Vengurla- 2	6.1	81.6	Medium	Long	2.29	35.46	4.8	28.0
Vengurla- 3	6.1	97.1	Sparse	Medium	3.15	37.24	6.2	30.0
Vengurla- 4	5.1	79.5	Sparse	Medium	3.40	25.06	6.3	29.5
Vengurla- 5	5.8	83.6	Compact	Medium	3.78	52.34	4.9	28.0
Bapatla - 1	5.7	74.7	Compact	Medium	3.33	24.67	4.8	29.0
Bapatla - 3	5.6	87.0	Medium	Medium	--	24.21	---	---
Bapatla - 4	5.8	88.6	Medium	Long	--	26.44	---	---
Bapatla - 5	5.7	80.4	Compact	Medium	0.50	30.80	5.2	28.5
Bapatla - 6	5.9	95.7	Compact	Medium	--	40.55	---	---
SEm ±	0.12	2.14						
CD 5%	NS	NS						
CV %	6.91	7.90						

No significant difference in plant height was observed among varieties. However, the maximum plant height (6.13 m) was recorded from Vengurla - 2 followed by Vengurla - 3 (6.06 m) and the least (5.07 m) from Vengurla - 4. The varieties did not differ significantly in their stem girth. Vengurla-3 recorded the maximum stem girth (97.1 cm) and the least (74.7 cm) by the Bapatla - 1. Since some entries/varieties did not yield in different replications and few in all the replications, statistical analysis was not done. However, Vengurla - 5 (3.78 kg/tree) recorded highest mean yield followed by Vengurla - 4 (3.40 kg/tree).

The highest cumulative yield (9 harvests) of 52.34 kg/tree was recorded from Vengurla - 5 followed by Bapatla - 6 (40.55 kg/tree) and Vengurla - 3 (37.24 kg/tree). Bapatla - 3 and Bapatla - 1 recorded lower cumulative yield of 24.21 and 24.67 kg/tree, respectively.

Significant differences in nut size were observed where the nut size varied between 4.81 and 6.21g. Varieties, Vengurla-3 and Vengurla-4 registered nut weight about 6.0g. The shelling percentage was high in Vengurla-3 (30%) while in all others shelling percentage was recorded about 28 only.

Expt. 2 : Multi location trial-86 with varieties from Vittal, Vridhachalam, Vengurle, Bapatla and Madakkathara (MLT 86).

Centers:

East Coast : Bhubaneswar and Jhargram

West Coast : Madakkathara and Vengurle

Maidan tract : Chintamani

The objectives are to evaluate performance of high yielding varieties in different locations.

Design	: RBD
Replication	: Three
Varieties	: No. of entries: 19
Bapatla entries	: T.No.40, T.No.129, H 2/15, H 2/16
Vengurle entries	: V-2, V-3, V-4, V-5 (H-24), M 44/3 (VRI-2)
Vridhachalam entries	: M 26/2, M 33/3, M 44/3 (VRI-2)
Vittal entries	: VTH 30/4, VTH 59/2, M 44/3 (VRI-2)
Madakkathara entries	: H 1598 (Kanaka), H 1600, H 1608 (Dhana), H 1610
Year of planting	: 1986

At Bhubaneswar, during 1998, biometrical analyses were done on plant height, girth, spread of the plants in which significant variations were recorded among varieties. Maximum plant height was recorded in Vengurle-2 (6.5m) followed by H 1610 (6.3 m), Vengurle - 3 (6.1 m) and minimum plant height in M 44/3 (4.4 m), H 1600 (4.6 m) (Table 1.11). Maximum girth of the plant was observed in H 1600 (94.2) followed by H 1608 (93.1), BPT 40 (90.0) and minimum in VTH 59/2 (55.5). The spread of the plant was maximum in both the directions in H 1610 followed by VTH 30/4 and minimum in VTH 59/2. The cashew types and BPT 40, 2/15, 2/16, ML 6/2, M 44/3, Vengurle-2 were found early flowering types BPT 40

produced off season flowers. Varieties like H 1600, H. 1610, T 129, VTH 59/2 and Vengurle-3 were found late flowering and fruiting types.

The number of flowering panicles was found maximum in the variety BPT 40 (32.0) followed by H 1600 (30.0), M 26/2 (28.5) and minimum in T 129 (22.0) (Table 1.12). The length of panicles ranged from 17.5 cm in VTH 44/3 to 29.5 cm in H 1610. The number of nuts per panicle was minimum in H 2/15 (1.6) and maximum M 26/2 (8.6) followed by H 2/16 (7.3), Vengurle-3 (6.7). The 100 nut weight found maximum in H 1610 (1000g) followed by H 2/16 (9159), H 1608 (845 g), Vengurle-4 (830 g) and minimum in M 44/3 (510 g). During 1998 harvesting season significant

increase in yield was recorded in H 2/16 (17.10 kg/tree) followed by H 1608 (13.35 kg), H 1600 (10.05 kg), Vengurla-4 (9.45 kg) and minimum in T 129 (3.0 kg) and VTH 44/3 (3.85 kg). The cumulative

yield for 7 harvests was found maximum in H 2/16 53.60 kg/tree followed by H 1608 (42.35 kg), Vengurla-4 (29.65 kg), H 1598 (28.4 kg) and minimum in VTH 44/3 (13.55 kg) and M 44/3 (14.70 kg).

Table-1.11 : Characteristics of different cashew varieties under MLT-86 at Bhubaneswar

Variety	Plant Height (m)	Girth (cm)	Spread of the plant (m)		Flowering period
			E-W	N-S	
H 1598	5.35	75.02	8.35	8.55	Mid-season
H 1600	4.55	72.00	8.05	8.00	Late
H 1608	5.52	93.10	9.35	8.95	Mid-season
H 1610	6.32	94.15	9.55	10.00	Late
T 129	5.31	94.15	8.92	8.10	Late
BPT 40	5.10	90.00	8.45	8.75	Early
H 2/16	5.65	77.25	7.55	9.40	Early
H 2/15	5.50	81.60	8.80	8.75	Early
M 44/3	4.40	85.60	7.10	6.95	Early
M 26/2	4.85	67.60	7.60	7.85	Early
VTH 44/3	5.15	77.85	6.25	7.70	Early
VTH 30/4	5.85	69.50	8.90	9.30	Late
VTH 59/2	4.35	55.50	6.15	6.10	Late
V 2	6.45	79.10	8.80	8.80	Early
V 3	6.05	85.50	8.90	8.55	Late
V 4	5.45	65.10	7.85	7.30	Mid-season
SE m ±	0.29	5.70	0.42	0.54	
C.D. 5%	0.88	17.20	1.27	1.63	

Table 1.12: Flowering and yield attributes of cashew types in MLT-86 at Bhubaneswar

Variety	No. of panicles/ sq. m.	Length of panicle	No. of nuts/ panicle	100 nut weight (g)	Yield/ Plant (kg)	Cum. Yield (kg) 7 harvests	Apple weight (g)	Shelling (%)
H 1598	26.0	22.3	5.4	600	9.50	28.40	58.0	32.0
H 1600	30.0	24.6	4.8	800	10.05	23.55	53.0	29.0
H 1608	28.0	22.7	3.6	845	13.35	42.35	73.0	28.5
H 1610	26.0	29.5	3.1	1000	7.70	20.10	60.0	26.0
T 129	22.0	17.9	2.4	595	3.00	16.00	47.0	30.0
BPT 40	32.0	22.0	5.2	615	8.00	24.90	42.0	32.0
H 2/15	26.0	19.0	1.6	970	7.00	21.20	67.5	28.0
H 2/16	26.5	24.0	7.3	915	17.10	53.60	55.0	29.5
M 44/3	26.0	18.0	5.3	510	5.50	14.70	25.0	31.5
M 26/2	26.5	18.4	8.6	515	7.05	22.65	32.5	32.4
VTH 44/3	25.5	17.5	4.9	530	3.85	13.55	28.5	32.0
VTH 30/4	26.0	25.0	3.0	825	8.20	21.40	86.0	29.0
VTH 59/2	24.0	23.5	4.6	655	6.10	16.60	45.0	32.0
Veng.2	28.0	25.2	5.4	590	8.25	26.45	43.5	32.0
Veng.3	28.0	22.7	6.7	790	8.30	24.10	52.0	29.5
Veng.4	23.0	20.9	5.8	830	9.45	29.65	47.0	31.0
SE m ±					0.79			
C.D. 5%					2.39			

At Chintamani, significant differences were observed among entries with respect to plant height. The maximum height of 5.4 m was recorded in H 1610 and was superior over all the entries (Table 1.13). The least height was in Vengurla-2 (4.2m). Significant difference in stem girth among varieties was observed. The maximum stem girth of 84.3 cm was recorded from H 1610 followed by TN - 40 (77.3 cm) and the least of 59.8 cm was recorded from Vengurla - 2.

Since many entries did not yield in different replications, statistical analysis was not done. However M 44/3 (VRI source) recorded the highest yield of 4.60 kg/tree followed by H 1608, H 1600 and M 44/3 (VTH-12). The entry M 44/3 (VRI source) recorded highest mean nut yield of 4.92 kg/tree/year followed by H 1608 (3.88 kg/tree) with nut size of 4.3g and 5.3g respectively.

At Jhargram, vegetative growth was high in respect of plant height and girth

in the variety VTH 30/4, which recorded a mean height of 5.9 m and girth 94.3 cm, followed by H 1610 having the height and girth of 5.5 m and 94.2 cm

respectively (Table 1.14). The highest nut yield per tree was recorded in H 2/16 (7.28kg) followed by VTH 59/2 (6.28 kg), VTH 30/4 (5.68kg) and H 2/15 (5.67 kg).

Table 1.13 : Performance of cashew varieties in MLT-86 at Chintamani.

Varieties	Height (m)	Girth (cm)	Canopy shape	Yield (kg/tree)		Mean (9 years)	Nut weight
				1998	Cum.		
H 1598	4.89	71.03	Medium	3.25	29.30	3.26	6.4
H 1600	4.94	76.02	Compact	--	28.84	3.20	--
H 1608	4.70	74.47	Medium	3.65	34.90	3.88	5.3
H 1610	5.38	84.27	Medium	3.50	31.29	3.48	6.3
TN 129	4.86	74.57	Medium	--	23.55	2.62	--
TN 40	4.52	77.28	Compact	3.40	23.38	2.60	5.2
H 2/15	4.83	66.70	Compact	1.40	26.30	2.92	5.7
H 2/16	4.87	71.40	Sparse	--	22.04	2.45	--
Vengurle-2	4.18	59.80	Sparse	2.10	20.17	2.24	4.0
Vengurle-3	4.66	73.77	Sparse	2.45	26.46	2.94	7.0
Vengurle-4	4.95	73.80	Sparse	--	25.18	2.80	--
H 24 (V-5)	4.96	73.93	Compact	2.50	30.64	3.40	3.8
M 44/3	4.66	67.03	Compact	2.10	18.40	2.04	4.6
M 44/3 (VRI)	4.39	68.33	Compact	4.60	44.25	4.92	4.3
M 44/3 (VTH-2)	4.75	67.87	Compact	3.50	26.90	2.99	5.0
M 30/4 (VTH 30)	4.76	64.07	Medium	2.15	21.85	2.43	4.3
59/2 (VTH 59)	4.83	72.53	Sparse	--	25.10	2.79	--
SE m ±	0.09	1.28					
CD 5%	0.27	3.74					
CV %	7.89	7.40					

Table 1.14 : Growth and yield performance of varieties in MLT-86 at Jhargram.

Varieties	Height (m)	Girth (cm)	Canopy Shape	Yield/tree (kg)
VTH 30/4	5.9	94.3	Compact	5.68
VTH 59/2	4.4	74.7	Medium	6.28
H 2/15	5.2	72.0	Compact	5.67
H 2/16	5.1	81.6	Medium	7.28
TN 40	5.0	74.2	Compact	5.01
TN 129	5.4	66.2	Medium	4.68
H 1608	4.4	74.2	Compact	3.29
H 1598	4.2	69.7	Medium	4.71
H 1600	3.3	56.1	Medium	4.31
H 1610	5.5	94.2	Medium	4.28
M 26/2	2.9	62.4	Sparse	4.11
M 33/3	4.8	63.2	Medium	5.55
M 44/3	3.8	54.1	Semi-dwarf	3.77
CD 5%	0.62	8.46		0.25

The yield data of cashew varieties from Jhargram has been presented in Table 1.15 for seven harvests. During the year 1998 variety H 2./16 performed well

with an yield of 7.28 kg/tree/year. However seven year cumulative yield data indicated better performance of VTH 59/2.

Table 1.15 : Yield data of cashew varieties in MLT 86 at Jhargram from 1992-98.

Varieties	Yield kg/tree							Cumulative Yield (kg)
	1992	1993	1994	1995	1996	1997	1998	
H 1598	3.32	3.74	4.02	4.36	4.51	4.68	4.71	29.34
H 1600	2.96	3.83	3.28	3.47	4.01	4.23	4.31	26.09
H 1608	2.42	4.62	3.16	3.38	3.35	3.47	3.29	23.69
H 1610	2.63	3.91	3.30	3.92	3.94	4.21	4.28	26.19
TN 129	3.67	4.65	4.79	4.34	4.52	4.87	4.68	31.42
TN 40	2.84	3.72	5.17	4.82	4.95	5.12	5.01	31.61
H 2/15	3.37	5.14	5.52	5.61	5.70	5.57	5.67	36.58
H 2/16	3.49	5.89	6.35	5.78	5.83	6.12	7.28	40.74
M 33/3	2.65	4.68	5.72	5.16	5.66	5.35	5.55	34.11
M 26/2	2.72	4.01	3.08	3.49	4.01	4.21	4.11	25.63
M 44/3	2.29	3.17	2.96	3.42	3.44	3.76	3.77	22.81
VTH 30/4	2.36	5.24	6.28	5.94	6.04	5.87	5.68	37.41
VTH 59/2	4.26	6.74	8.17	7.68	7.52	7.92	6.28	48.57
SE m ±	0.298	0.361	0.228	0.230	0.28	0.07	0.12	
CD	0.870	1.053	0.667	0.671	0.57	0.14	0.25	

At Madakkathara, among the 18 varieties evaluated V-3 was the tallest (8.7m) followed by H - 1610 (7.9m) and V-4 (7.3m). Variety M 44/3 was shortest (5.7 m) (Table 1.16). Variety H 1610 had the highest girth (118.3 cm) followed by V-3 (105.1 cm) and then H 1600 (100.5 cm). Variety M 44/3 had the lowest girth (70.2cm) followed by V-2 (78.3 cm) and Anakkayam-1 (81.3 cm). H 1610 had the highest canopy spread (10.8 m)

followed by V-3 (10.5m). The variety M 44/3 had the lowest canopy spread (8.1m) followed by V-2 (8.4m) and Anakkayam - 1 (8.5m).

There was significant difference in nut yield between varieties during different years of harvest. In all the years, the yield (year wise, mean and cumulative yields) was high with the varieties M 26/2, H 1598, V5, M 44/3, and H 1608 (Table 1.17).

Table 1.16 : Growth characters in MLT 86 at Madakkathara.

Variety	Height (m)	Girth (cm)	Canopy spread (cm)
H 1598	6.9	94.3	9.7
H 1600	6.2	100.5	9.6
H 1608	6.6	86.7	9.1
H 1610	7.9	118.3	10.8
T 30/4	6.6	91.7	9.6
T 59/2	6.9	95.5	9.6
T 129	6.5	97.3	10.0
T 40	6.5	90.0	8.8
H 2/15	6.5	96.7	10.2
H 2/16	7.0	88.9	9.8
V 2	6.8	78.3	8.4
V 3	8.7	105.1	10.5
V 4	7.3	90.4	9.5
V 5	6.5	93.3	9.3
M 33/3	6.7	84.3	9.1
M 44/3	5.7	70.2	8.1
M 26/2	6.7	92.9	9.2
AKM - 1	6.4	81.3	8.5
CD	0.73	8.58	0.83

Table 1.17: Variation in yield, processing characters and income in respect of 18 cashew varieties in MLT-86 at Madakkathara.

Variety/ No of harvest	Yield (kg/tree) in different harvests								Cum. Yield (kg/ tree)	Mean (kg)/ tree	Yield (kg/ ha)	Nut Wt (g)	Ker-nel Wt. (g)	Shellin g %	Net income (Nut) Rs.
	1	2	3	4	5	6	7	8							
M 26/2	3.38	6.58	14.47	10.00	10.22	11.99	10.54	12.88	80.06	10.0	1781	7.3	2.5	34.8	53448
H1598	4.64	3.63	11.67	12.17	11.04	13.18	11.89	8.86	77.08	9.6	1715	6.0	2.1	34.4	51128
V5	1.46	3.18	9.00	12.10	13.89	12.72	10.63	9.88	72.86	9.1	1621	4.0	1.3	32.7	47836
M44/3	5.48	6.81	10.70	11.20	10.17	10.50	9.33	8.43	72.61	9.1	1616	3.5	1.3	36.4	47647
H 1608	2.98	2.68	11.97	9.33	7.77	10.50	11.89	7.50	64.62	8.1	1438	8.2	2.4	29.8	41421
AKM-1	2.70	2.12	11.00	10.87	9.64	12.21	7.44	7.20	63.17	7.9	1406	5.9	2.2	37.0	40295
H11600	2.59	4.96	11.33	8.20	6.80	5.83	13.14	8.27	61.12	7.6	1360	6.1	2.0	32.5	38699
T30/4	2.03	3.28	9.83	7.60	9.73	6.87	8.98	10.82	59.13	7.4	1316	5.4	1.9	36.0	37150
V3	1.66	3.00	11.52	8.73	7.09	3.96	15.73	5.02	56.71	7.1	1262	7.0	2.1	30.6	35261
V4	1.31	2.58	11.83	7.53	6.91	3.22	10.17	9.58	53.13	6.6	1182	8.0	2.5	30.9	32473
M33/3	1.90	3.67	11.15	7.30	5.41	4.70	8.16	10.22	52.51	6.6	1168	8.9	2.9	32.5	31992
H 2/15	1.47	1.84	6.47	7.33	8.03	5.91	7.29	6.42	44.76	5.6	996	8.0	2.6	32.0	25958
T 59/2	1.84	3.58	9.17	5.27	5.57	4.01	6.91	3.12	39.48	4.9	878	7.6	2.1	28.1	21841
H 2/16	1.50	1.71	7.87	4.80	4.81	3.67	6.22	6.14	36.71	4.6	817	9.0	2.8	30.6	19689
T 40	0.91	3.17	5.23	4.50	4.67	3.81	5.66	6.30	34.25	4.3	762	5.5	1.8	33.5	17768
H 1610	0.56	1.78	8.17	5.13	2.20	3.97	7.96	4.36	34.12	4.3	759	8.3	2.5	29.7	17671
T 129	0.87	1.79	5.90	3.03	3.46	4.00	6.28	4.64	29.97	3.7	667	5.8	1.9	33.4	14439
V2	1.28	2.83	7.27	4.27	5.26	2.46	2.62	3.53	29.52	3.7	738	6.6	1.9	28.5	16926
CD 5%	1.23	1.70	3.47	2.15	3.21	3.10	4.33	3.69							

In MLT 86 at Vengurle, the variety Vengurla-3 had recorded maximum tree height (5.2 m) and girth (83.0cm) (Table 1.18). The minimum height was recorded in variety M 44/3 (3.9 m) and minimum in H 2/15 (62 cm). The canopy spread was a minimum with N-S spread

(6.9 m) and E-W spread (6.4 m) in M 44/3. Vengurla - 5 recorded maximum yield (7.10 kg nut/tree) followed by Vengurla-4 (5.2 kg nut/tree) and Vengurle-3 (4.9 kg nut/tree). The variety T/40 had recorded the lowest yield of 2.6 kg/tree.

Table 1.18: Yield data of cashew varieties in MLT 86 at Vengurle.

Variety	Height (m)	Girth (m)	Spread (m)		No. of flowering panicles	Nut yield (kg)/tree	Mean nut weight (g)	Shelling %
			N-S	E-W				
V 2	4.9	76	8.0	8.3	20.6	3.3	4.25	32
V 3	5.2	83	8.5	8.1	22.2	4.9	9.00	27
V 4	5.0	76	8.6	8.6	21.4	5.2	7.67	30
V 5	4.2	67	7.3	7.6	30.9	7.1	4.30	30
H 1598	5.0	78	7.9	7.5	21.2	4.5	5.70	30
H 1600	4.2	69	7.5	7.8	26.7	4.1	6.65	28
H 1608	4.5	80	8.1	8.7	27.1	3.6	7.75	28
H 1610	4.3	73	8.6	8.5	22.3	4.5	7.90	30
T 129	4.1	73	8.6	7.7	22.0	4.1	7.25	30
T 40	4.9	80	8.5	8.8	24.1	2.6	6.50	29
M 44/3	3.9	70	6.9	6.47	41.1	2.8	5.10	30
H 2/15	4.1	62	8.4	8.8	27.6	3.5	7.50	28
H 2/16	4.1	72	8.4	8.9	24.6	3.5	7.10	28
H 30/4	5.0	76	8.0	7.3	30.2	3.5	5.65	28
H 59/2	5.0	76	8.2	9.1	24.2	4.6	7.00	29
SE m ±	0.239	5.684	0.575	0.774	2.452	0.946	--	--
CD 5%	0.652	NS	NS	NS	7.107	NS	--	--

Expt. 3 : Multi location trial-92 with varieties from Bapatla, Vengurle, Vridhachalam, and NRC Cashew, Puttur (MLT-92).

Centres :

East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast : Madakkathara and Vengurle

Maidan tracts : Chintamani and Jagdalpur

The objectives of the experiment are to evaluate the performance of new high yielding varieties in different locations.

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

At Bapatla, the new multi-location trial - 92 was laid out during January 1993. During this period T.No. 10/19 recorded higher plant height, girth and plant spreading than other entries, while H-255 recorded the least. The flowering intensity and floral characters associated with each variety were recorded during 1998. The different attributes such as no. of flowering laterals, total no. of flowers/panicle, percentage of staminate

and hermaphrodite flowers were recorded and plotted in Fig.1. M.44/3 recorded higher nut yield followed by M 15/4 and 10/19 during 1998 (Table 1.19). The cumulative nut yields were higher in M 15/4 followed by M 44/3 and 10/19. M 15/4 produced more number of nuts per panicle followed by T.No.10/19, H-320, H-68 and H-367. Fruit set percentage was higher in M 15/4, T. No. 10/19 and M 44/3.

Fig. 1 : Flowering characters of high yielding varieties under MLT 92 at Bapatla.

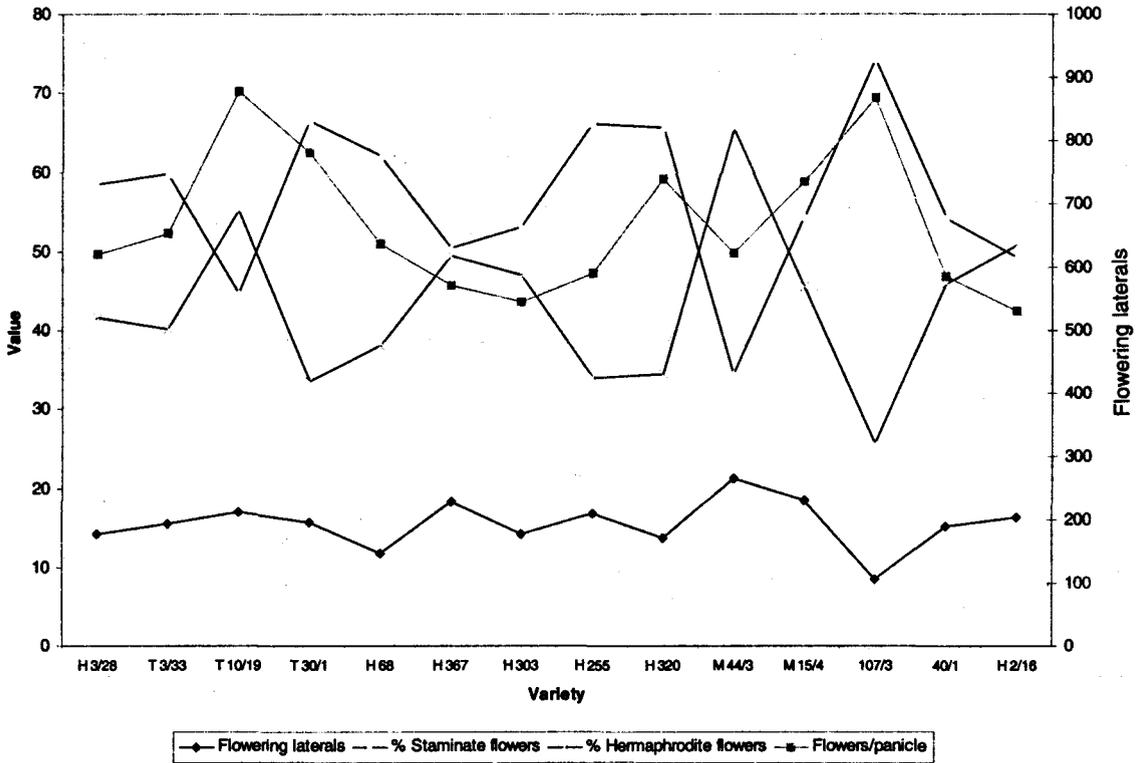


Table - 1.19: Fruit set and nut yield characters of high yielding varieties at Bapatla.

Varieties/Hybrid	No. of nuts per panicle	Yield/tree/year (kg)	Cumulative yield (kg)
H-3/28	4.75	0.97	2.65
3/33	5.50	1.01	2.28
10/19	15.0	1.48	3.34
30/1	5.50	1.10	2.92
H 68	3.50	0.65	1.33
H 367	6.00	1.54	1.88
H 303	4.75	0.87	1.91
H 255	3.00	0.27	0.50
H 320	4.50	0.65	1.50
M 44/3	7.25	2.24	4.20
M 15/4	17.50	1.88	4.38
VTH 107/3	3.25	0.49	2.01
VTH 40/1	6.25	1.10	2.10
H 2/16	5.75	1.30	1.30
CD at 5%	1.434	0.048	--
SE m ±	0.493	0.017	--

At Bhubaneswar, the flowering characters and the sex ratio of flowers of different varieties under MLT 92 at Bhubaneswar is presented here below in Table 1.20. Maximum growth was recorded for H 255 followed by H 303 and H 320 which were all early flowering varieties.

The yield of nuts per plant varied significantly among the cashew types.

On 3rd harvest highest yield was recorded in 30/1 (8.0 kg/tree), followed by H 303 (5.76 kg), H 320 (4.60 kg) and minimum in VTH-107/3 (1.53 kg/tree) (Table 1.21). The sex ratio of the cashew type M 44/3 was maximum (0.67) followed by VTH-107/3 (0.43), H 303 (0.36) and minimum in 10/19 (0.12). Cashew types M 44/3, 30/1, 3/28, H 303 produced earlier flowering whereas VTH 107/3, H 255 flowered late.

Table - 1.20: Vegetative characters of cashew varieties in MLT- 92 at Bhubaneswar.

Variety	Height (m)	Girth (cm)	Canopy spread (m)		Sex Ratio	Flowering period
			E-W	N-S		
VTH 107/3	3.20	45.9	4.3	4.6	0.43	Late
VTH 40/1	3.00	39.6	4.9	4.6	0.14	Mid season
M 44/3	3.60	42.2	4.8	5.0	0.67	Early
M 15/4	3.80	52.7	5.3	5.4	0.15	Mid season
3/33	4.50	59.7	6.7	6.9	0.16	Mid season
10/19	4.30	58.2	6.9	7.1	0.12	Mid season
30/1	4.40	54.2	6.7	7.0	0.25	Early
3/28	4.40	59.4	7.0	7.0	0.34	Early
H 303	4.60	58.0	7.5	6.7	0.36	Early
H 320	4.60	57.9	7.2	7.2	0.33	Early
H 255	4.65	60.4	8.2	7.8	0.32	Late
H 367	3.60	52.4	6.9	6.7	0.27	Mid season
H 68	4.30	54.0	5.8	6.0	0.18	Mid season
SE m ±	0.25	3.27	0.16	0.50	--	--
CD 5%	0.73	9.54	0.46	1.46	--	--

Table - 1.21: Flowering and yield attributes of cashew in MLT- 92 at Bhubaneswar.

Variety	Length of panicle (cm)	No. of panicle /sq. m	No. of nuts/ panicle	100 nut weight (g)	Apple weight	Yield kg/tree				Shelling (%)
						1996	1997	1998	Cum. 3 har	
VTH 107/3	25.5	22.0	3.0	720.0	50.0	0.66	0.39	1.53	2.58	29.5
VTH 40/1	22.5	24.0	4.0	940.0	62.0	0.85	1.41	3.36	5.62	30.0
M 44/3	17.5	26.0	6.0	553.0	25.0	0.87	1.94	2.76	5.57	32.0
M 15/4	16.0	24.0	2.5	627.0	49.0	0.61	3.30	2.10	6.01	31.0
3/33	19.5	26.0	5.2	550.0	44.0	1.31	1.15	3.61	6.07	29.8
10/19	18.5	20.0	5.0	643.0	47.5	1.09	1.35	2.65	5.09	32.0
30/1	23.0	24.0	5.6	573.0	27.0	1.18	1.28	8.00	10.46	32.5
3/28	19.0	21.6	6.8	730.0	62.0	0.74	1.40	3.76	5.90	31.0
H 303	17.5	18.4	6.2	893.0	65.0	1.61	3.03	5.76	10.40	29.5
H 320	22.5	20.0	5.8	800.0	67.0	1.91	4.66	4.60	11.17	29.0
H 255	24.0	22.0	3.5	887.0	63.0	1.21	3.74	3.55	8.50	32.0
H 367	23.6	22.0	3.2	997.0	74.0	0.65	1.67	4.20	6.52	28.5
H 68	23.0	26.0	5.5	830.0	50.0	1.68	1.55	3.15	6.38	29.0
SE m ±				7.65		0.17	0.23	0.39		
C.D.5 %				22.29		0.49	0.66	1.14		

At Chintamani, significant differences in plant height among entries were noticed. The entry VTH 107/3 recorded the highest plant height (4.7 m) followed by H 320 (4.5 m) and the least was in M 44/3 (3.2 m) (Table 1.22). Stem girth also varied significantly among varieties. The entry H 68 attained the

maximum stem girth of 60.7 cm followed by VTH 107/3 and H 302. The least girth was recorded in M 44/3 (43.2 cm). The east-west plant spread varied significantly among varieties. The entry H 255 recorded the maximum spread (6.6 m) while the least was from M 44/3 (4.2 m).

Table - 1.22: Performance of cashew varieties in MLT- 92 at Chintamani.

Varieties	Height (m)	Girth (cm)	Canopy spread (m)		Yield (kg/tree)		Nut Weight (g)
			E-W	N-S	1998 *	Cum **	
H 68	4.0	60.7	5.77	6.10	2.40	5.67	--
H 367	3.9	53.9	5.90	5.30	4.15	4.31	7.4
H 302	3.7	60.0	6.27	5.78	1.10	10.79	6.4
H 255	4.2	58.0	6.55	6.54	1.28	4.44	8.1
H 320	4.5	54.2	5.41	5.61	2.28	8.38	7.5
M 44/3	3.2	43.2	4.23	4.24	1.48	6.65	4.2
M 15/4	3.7	47.4	5.01	5.37	2.21	4.48	6.0
VTH 107/3	4.7	60.4	6.32	6.30	5.50	4.73	7.0
VTH 40/1	3.9	45.8	5.22	5.62	1.36	11.57	7.4
30/1	3.6	47.7	5.46	5.13	1.40	5.61	4.8
3/33	4.5	56.8	5.93	6.34	--	4.21	--
10/19	4.2	53.7	5.52	4.97	1.21	3.98	5.7
3/28	4.3	56.7	5.65	6.00	1.50	8.15	5.5
Ullal	14.2	59.5	5.54	6.02	--	3.90	6.3
SEM ±	0.11	1.62	0.18	0.20			
CD 5%	0.24	3.50	0.39	NS			
CV %	10.66	11.16	11.86	13.67			

* Analysis was not done because of no yield in some replications and in one variety

** 4 Harvests.

There was no significant difference among entries with respect to north-south canopy spread. However, highest spread was in H 255 (6.54 m). Statistical analysis was not carried out for nut yield and nut weight because of no yield in some replications. However, VTH 107/3 recorded the highest nut yield of 5.50 kg/tree followed by H 367 (4.15 kg/tree). The highest four years cumulative yield was recorded from VTH 40/1 (11.57 kg/tree), H 302 (10.79 kg/tree), H 320 (8.38 kg/tree) (Table 1.22). As far as nut size is concerned, quite a few entries were found to be promising as they recorded more than 7.0g nut weight.

At Jagdalpur, maximum survival

was recorded in VTH 40/1, M 15/4 and M 44/3 (Table 1.23). The maximum plant height was recorded in H 68 followed by H 1514 and VTH 40/1. The maximum stem girth was recorded for H 68 followed by H 367, M 44/3 and VTH 107/3. The maximum number of plants in flowering stage was recorded in M 15/4 followed by H 303 during November 1997. During December 97, maximum flowering was recorded in H 68, H 303 and H 367 followed by M 15/4. In January 1998, maximum flowering was recorded in H 68, H 303, H 367 followed by VTH 40/1. During March maximum flowering was recorded in H 68, H 303, H 367, VTH 40/1 and 30/1.

Table - 1.23 : Evaluation of MLT- 92 varieties at Jagdalpur.

Variety	Per cent survival	Plant height (cm)	Plant girth (cm)	No. of primary branches	Plant spread (cm)	
					N-S	E-W
H 3/28	66.7	157.1	22.1	4.1	224.2	233.1
H 3/33	22.2	102.5	14.1	4.5	75.0	116.3
H 10/19	40.0	110.0	12.5	4.7	118.7	226.2
30/1	55.5	145.2	23.6	4.0	213.3	203.7
M 15/4	83.3	206.5	25.5	5.1	259.8	257.6
M 44/3	83.3	202.0	24.8	5.1	251.5	253.6
VTH 107/3	72.2	204.5	26.4	4.9	263.8	262.0
VTH 40/1	83.3	205.7	25.6	5.1	280.3	299.5
H 68	5.5	238.0	43.0	4.3	276.6	296.6
H 303	16.6	190.0	38.0	4.0	260.0	270.0
H 367	11.1	200.0	42.2	4.0	345.0	310.0

At Jhargram, maximum plant height (3.6 m) and girth (44.0 cm) was noticed in H 255 followed by H 320 (3.3 m) and 3/33 (2.6m) in respect of plant height whereas, H 303 (36.0 cm) and H

320 (35.0 cm), in respect of girth. Lowest plant height and girth was recorded in M 44/3 (1.80 m and 21.0 cm) respectively (Table 1.24).

Table - 1.24 : Growth parameters of different cashew cultivars under new MLT-92 at Jhargram.

Varieties	Height (m)	Girth (cm)
30/1	2.4	25.3
3/33	2.6	29.2
H 303	2.5	36.0
H 255	3.6	44.0
H 320	3.3	35.0
M 44/3	1.8	21.0
VTH 40/1	2.1	26.0

At Madakkathara, VTH 107/3 and 3/33 were the tallest (3.9m) and H 367 was the shortest one (2.7 m) (Table 1.25). The girth in VTH 40/1 was also the highest (54.2cm) and M 44/3 was the

lowest (31.3 cm). During this year, yield was obtained in only eight varieties, of which M 15/4 yielded the highest (840g/tree) followed by H-320 (600g).

Table - 1.25 : Yield performance of cashew varieties in MLT-92 at Madakkathara.

Variety	Height (m)	Girth (cm)	Canopy spread (m)	Yield (g/tree)
30/1	3.8	38.3	4.16	275
3/33	3.9	39.4	3.7	0
10/19	3.6	37.0	3.17	400
3/28	3.3	37.1	3.49	0
H 68	3.3	35.8	2.65	0
H 367	2.7	35.8	2.98	300
H 303	3.6	35.0	2.06	100
H 255	3.7	35.8	3.35	0
H 320	3.2	35.4	3.27	600
M 44/3	2.8	31.3	3.67	550
M 15/4	2.9	34.6	3.74	840
VTH 107/3	3.9	42.6	3.24	0
VTH 40/1	2.9	54.2	3.59	50
Dhana	3.3	35.7	3.61	0
SE m ±	0.27	2.58	0.23	
CD 5%	0.57	5.42	0.49	

At Vridhachalam, the plant girth was maximum in M 15/4 (39.72 cm) and minimum in M 44/3 (27.2 cm). Maximum height was observed in M 15/4 (3.8 m) and minimum in H 367 (2.6 m). The highest nut weight was observed in VTH 107/3 (9.0g) and least weight was seen in H 68 (5.3g). 10/19 had shelling

percentage of 31.3%, which was maximum, and least shelling percentage was observed in M 15/4 (22.5%). The highest yield was obtained for the Vridhachalam entry, M 44/3 (2.40kg) followed by VTH 40/1 (2.23 Kg/tree) (Table 1.26).

Table - 1.26 : Performance of different cashew varieties in MLT-92 in Vridhachalam

Variety	Girth (cm)	Height (m)	Yield kg/tree	Flowering period	Nut weight (g)	No. of fruits/ panicle	Shelling %
3/28	28.8	3.0	0.50	Late	7.4	4.5	23.7
3/33	27.5	3.1	1.10	Mid-season	8.5	5.5	23.1
10/19	31.2	3.2	0.45	Early	5.7	3.4	31.3
30/1	24.0	2.6	0.57	Early	7.7	3.3	27.3
H 68	30.8	3.1	1.00	Mid-season	5.3	5.5	27.4
H 255	28.4	2.7	0.70	Mid-season	5.4	6.7	28.4
H 303	32.8	3.2	1.10	Mid-season	8.0	5.7	24.9
H 320	28.8	2.6	0.93	Early	8.2	3.0	26.3
H 367	33.0	2.6	1.53	Early	6.8	2.7	23.1
M 44/3	27.2	2.9	2.40	Early	7.8	9.6	24.7
M 15/4	39.7	3.8	1.57	Early	7.8	8.9	22.5
VTH 107/3	34.5	3.7	0.85	Late	9.0	3.3	26.9
VTH 40/1	27.3	2.8	2.23	Mid-season	8.9	5.1	26.7

Expt. 4 : Evaluation of released varieties.**Centres :****East Coast : Bhubaneswar****Maidan tract : Jagdalpur**

The evaluation of released varieties is being done at various centres for understanding the performance of these varieties under different agro-climatic conditions. Under this programme at Bhubaneswar, 22 varieties were evaluated during the year. Out of which BPP 1 and Ullal 2 have yielded the best with a yield each of 3.2 kg/tree. The nut

weight was more in Ullal-2 (5.5g) as compared to BPP-1 (4.9g) (Table 1.27). At Jagdalpur, the performance of Vengurla-1 and Vengurla-4 was found to be superior to other released varieties in terms of characters like survival of plants, plant height and spread of the canopy (Table 1.28).

Table 1.27 : Yield data of released cashew varieties during 1998 at Bhubaneswar.

Variety	Flowering period	Yield kg/tree	Nut weight (g)	No. of panicles/sq. m.
Vengurla-2	Medium	2.3	4.5	24
Vengurla-4	Medium	2.4	7.1	22
Vengurla-5	Late	1.0	4.3	24
BPP-1	Early	3.2	4.9	24
BPP-2	Early	1.75	4.2	26
BPP-4	Medium	3.1	5.1	22
BPP-5	Medium	2.1	5.0	26
BPP-6	Medium	1.7	5.2	26
BPP-8	Early	1.4	8.2	26
VRI-1	Medium	0.3	5.4	22
VRI-2	Early	2.0	4.8	25
VRI-3	Early	0.5	4.6	24
NRCC-1	Late	1.3	7.0	20
NRCC-2	Late	2.3	8.2	20
Ullal-1	Late	0.7	6.5	24
Ullal-2	Medium	3.2	5.5	26
Ullal-3	Medium	0.3	7.0	22
Ank-1	Early	2.5	5.6	24
Madk-1	Medium	3.3	6.5	26
BBSR-1	Early	3.0	4.6	26
Jhargram-1	Late	0.7	4.8	25
Dhana	Medium	0.5	8.0	26

Table-1.28: Evaluation of released varieties at Jagdalpur.

Variety	Per cent survival	Plant height (cm)	Plant girth (cm)	No. of primary branches	Plant spread (cm)	
					N-S	E-W
BPP – 1	14.2	60.0	6.2	4.0	170.0	50.0
BPP – 2	50.0	76.2	12.5	3.7	87.0	83.7
BPP – 4	33.3	90.0	11.5	4.0	91.6	91.6
BPP – 6	14.2	65.0	6.2	3.0	50.0	60.0
BPP – 8	33.3	61.6	8.3	3.3	73.3	66.6
Vengurla-1	88.8	226.0	29.3	5.8	269.1	266.1
Vengurla-4	100.0	220.0	27.2	5.1	285.8	292.2
Ullal-1	94.4	193.2	25.2	5.3	274.5	284.4
Ullal-2	88.8	208.5	23.5	4.5	250.3	263.2
H 1591	27.7	199.1	26.1	5.8	280.0	300.0
H 1598	55.5	191.4	23.2	3.8	264.0	259.7
H 1608	61.1	15.0	23.5	4.3	242.0	227.3
BLA 39/4	88.8	208.6	28.9	4.5	269.7	272.7
K 22/1	88.8	187.1	28.2	6.0	239.6	256.6
VRI - 3	80.0	76.8	11.3	3.1	92.5	88.1
Chintamani-1	80.0	61.8	11.0	3.4	59.3	53.7
NDR 2/1	66.6	187.8	26.4	6.1	262.5	255.8

Project Title : Gen. 4: Hybridisation and selection.

Centres :

East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast : Madakkathara and Vengurle

Maidan tract : Chintamani

Hybridisation was carried out in different stations by using high yielding local genotypes and other varieties. At Bapatla, 149 F1 seedlings were produced during the year. Bhubaneswar could achieve up to 14.4% success in crossing in BBSR-1 X VTH 711/4. At Chintamani, 26 different F1 hybrid trees got established. At Madakkathara yield of BLA-139/1 X P-3/2 was maximum (450 g) in first harvest. 16.1 kg/tree was obtained at Vengurle. At Vengurle above 170 nuts were obtained from different crosses. At Vridhachalam, M 44/3 X M 45/4 yielded highest of 3.5 kg/tree during the year.

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

During 1998 at Bapatla flowering season the hybridisation was done with different cross combinations and the details are furnished below :

Cross Combination	No. of nuts obtained
BPP-5 X 2/22	4
BPP-6 X 2/22	1
2/22 X BPP-6	2
2/22 X 228	2
228 X 2/22	8
228 X 30/1	10
273 x 71	14
71 x 273	24
30/1 x 228	7
BPP 6 x Tno.40	4
2/22 x BPP 8	2
BPP 8 x 228	16
F.T.No. 3 x 30/1	4
F.T.No.3 x 228	8
T.No.40 x BPP 6	1
Priyanka x BPP 8	10
Priyanka x 228	4
BPP 8 x Priyanka	7
228 x Priyanka	8
Priyanka x VRI 2	7
30/1 x Priyanka	5
Priyanka x 71	1

The total number of crossed nuts obtained is 149 and the germinated F1 seedlings are 125. Final establishment of F1 seedlings was 100.

The existing hybrid trees were evaluated and those, which recorded more than 10 kg of mean yield in 14

years of age and nut weight of more than 5g are given in the table below. The maximum yield of 12.5 kg was recorded by 4/1 (1x40) followed by 3/13 (56x40), which has recorded 7.9 kg during 1998 (Table 1.29).

Table - 1.29 : Evaluation of F 1 hybrids at Bapatla.

Hybrid	Parentage	Nut yield	Cumulative yield	Nut weight	Apple weight	Shelling %
2/15	1 x 40	7.8	143.2	5.2	60.0	28
3/10	56 x 40	5.3	127.5	5.8	32.0	29
3/13	56 x 40	7.9	171.2	5.0	28.0	28
3/25	56 x M 10/4	7.0	135.8	5.2	45.0	29.5
4/1	1 x 40	12.5	142.5	5.0	50.0	29.0

At Bhubaneswar, hybridisation work was conducted with the following cross combinations during this year:

Cross combination	Total No. of crosses done	No. of nuts obtained	% of success
M 44/3 x H 2/16	1130	38	3.36
H 2/16 x M 44/3	786	57	7.25
H 2/16 x M 26/2	498	59	11.84
M 44/3 x Kankadi	1125	42	3.73
M 44/3 x H 2/15	1020	24	2.35
Bhubaneswar-1 x Kankadi	575	33	5.73
Bhubaneswar-1 x H 2/15	209	21	10.04
Bhubaneswar-1 x VTH 711/4	361	52	14.40

A percentage of success more than 10% was recorded in the cross combinations Bhubaneswar-1 x VTH 711/4, H 2/16 x M 26/2 and Bhubaneswar-1 x H 2/15. While, minimum success percentage was observed in cross combinations M 44/3 x H 2/15 followed by M 44/3 x H 2/16 and

M 44/3 x Kankadi respectively. The hybrid seedlings have been planted in the main field for further evaluation.

The hybrids planted in 1995 produced nuts during 1998. The yield data of some of the promising types are as follows:

Table - 1.30: Evaluation of F 1 hybrids at Bhubaneswar.

Crosses	Yield kg/tree	Average nut weight	No. of nuts per panicle
BBSR-1 x Kankadi	0.600	8.6	4.3
BBSR-1 x Kankadi	1.500	8.0	6.0
BBSR-1 x Kankadi	0.650	6.7	5.3
BBSR-1 x VTH 711/4	0.500	11.0	3.5

At Chintamani, the F1 progenies of the cross 3/108 Gubbi x Vetore 56 have been planted in the field during August 1994. Out of the 25 seedlings planted, 19 established and all have flowered. Seven F1 hybrids were planted during 1998 and all have established in the field.

At Jhargram, during the year hybridisation was taken up with

different cross combinations using varieties Jhargram-1, M 44/3, BLA 39/4, 2/9 Dicherla, D.C.5, D.C. 8 and 6500 pollinations were made and the hybridization work is under standardisation.

At Madakkathara, the parentage of hybrids produced and year of planting are given below:

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

The growth characters (height, girth and canopy spread) of hybrids planting during 1993-97 (189 Nos.) were recorded. The yield data of hybrids planting during 1993 is also recorded. Out of the 56 hybrids planted in 1993, 10 hybrids

started yielding from 2nd year of planting and the yield ranged from 100-600gms/tree with the highest yield in H-10 followed by H-2 both of the parentage BLA 139/1 x P 3/2.

Table - 1.31: Yield obtained from hybrids at Madakkathara.

Hybrid No.	Year of planting	Height (m)	Girth (cm)	Canopy spread (m)	Yield (g)		
					1995-96	1996-97	1997-98
2	1993	5.5	50	6.75	200	--	450
7	1993	4.2	77	6.25	150	300	200
8	1993	4.6	56	6.55	300	650	200
9	1993	4.3	50	6.45	300	500	400
10	1993	4.1	56	5.30	200	300	600
13	1993	4.9	50	5.10	--	--	200
14	1993	5.1	55	5.25	--	--	300
15	1993	5.0	60	5.80	400	700	--
16	1993	5.3	62	5.95	--	--	200
18	1993	4.8	58	5.25	600	1100	100
19	1993	5.8	70	6.15	--	--	100
22	1993	5.0	60	5.20	--	--	200
24	1993	4.2	66	5.60	100	200	--
27	1993	5.0	66	5.30	--	--	300
42	1993	5.5	63	6.85	200	300	100
49	1993	4.3	65	5.80	150	200	--

During the year at Vengurle, the crossing work was undertaken with the following combinations:

Sl. No.	Cross Combinations	No. of F1 seed nuts obtained
1	Vengurla-2 x Bold type - 1	32
2	Vengurla-2 x Bold type - 22	21
3	Vengurla-2 x Bold type - 65	25
4	Vengurla-5 x Bold type - 1	26
5	Vengurla-5 x Bold type - 22	15
6	Vengurla-5 x Bold type - 65	19
7	Vengurla-4 x H 2/16	16
8	H 2/16 x Vengurla - 4	17

The hybrid No. 367 (V-4 x M-10/4) has given maximum nut yield of 16.10 kg/tree followed by H 320 (M 44/3 x Vetore-56) 12.05 kg/tree.

Table-1.32 : Information on Hybrids at Vengurle planted in 1983 and 1984.

Cross Combination	Hybrid No.	Mean yield for last 10 years	Highest yield obtained Kg/tree	Yield kg/tree	Nut wt. (g)	Shelling %
V-3 x M 44/3	248	5.86	10.39	7.65	6.21	28.00
V-4 x M 10/4	303	6.80	12.70	10.95	8.92	27.00
M 44/3 x Vetore-56	320	7.30	14.79	12.05	7.45	31.60
V-4 x M 10/4	367	10.47	22.47	16.10	11.50	28.00
M 10/4 x Vetore - 56	444	5.52	10.50	10.50	7.50	28.50
V-4 x Vetore-56	445	6.34	12.85	10.70	7.50	28.50
M 10/4 x Vetore-56	454	7.23	11.77	11.00	8.00	28.00
M 10/4 x Vetore-56	453	5.07	11.00	11.00	8.20	28.00
V-4 x M 44/3	509	6.37	9.40	9.40	6.00	29.00
V-4 x M 10/4	304	6.25	8.95	8.95	6.75	29.00

At Vridhachalam, the hybrid H 17 recorded the highest yield of 3.5 kg tree⁻¹. In H 13, the nuts were bolder with a mean weight of 7.3g. The cumulative yield for the nine years was highest in H 16 (30.2 kg). Further, crossing

programme is in progress using the parental lines H 2/15, H 2/16, H 1608, M 33/3, M 26/1, M 45/4, M 3/2, M 16/3, M 7/2, M 15/4, M 95/4, M 44/3 and M 10/4. A total of 33 F1 hybrids were established in the plantation at Bhavanisagar.

Table-1.33: Performance of hybrids at Vridhachalam.

Cross combination	Cumulative yield of 9 years (kg)	Highest yield obtained (kg/tree)	Yield (kg)	Apple Wt. (g)	Nut Weight (g)	Shelling %
M 10/4 x M 26/1 (H.10)	30.5	3.6	1.0	61.0	6.8	28.0
M 10/4xM 45/4 (H.11)	19.4	2.9	0.8	60.5	6.2	26.0
M 10/4xM 75/3 (H.12)	15.6	2.5	0.7	63.0	6.6	27.2
M 26/2 x M 26/1 (H.13)	28.5	4.5	1.2	65.8	7.3	26.2
M 26/2 x M 45/4 (H.14)	21.0	3.2	0.9	60.0	5.6	27.0
M 26/2xM 75/3 (H.15)	15.8	2.8	1.2	55.0	5.5	26.2
M 44/3 x M 26/1 (H.16)	30.2	5.0	2.0	60.0	6.8	28.2
M 44/3 x M 45/4 (H.17)	20.2	5.2	3.5	56.5	7.2	27.2

A. AGRONOMY

Project Title : Agr. 1: NPK fertilizer experiment.

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast : Madakkathara, Vengurle

Maidan tract : Chintamani

Doses of nitrogen up to 500g increased yield by increased number of flowering laterals per sq. meter and number of nuts per panicle. 1000g N : 250g P : 250g K was found to be a good fertilizer recommendation at Chintamani and Bhubaneswar.

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

Experimental details:

Design : Three factorial confounded design with 27 treatment combinations.

Replication : Two

**Treatments : N - 0,500, and 1000 g/plant
P - 0,125, and 250 g/plant
K - 0,125, and 250 g/plant.**

No. of plants per plot : Six

Bapatla:

The fertilizer treatments were imposed in two split applications during September and December 1998. Growth parameters like girth, height and spread were recorded and statistically analysed.

It is observed that the plant height, girth and spread increased significantly with the nitrogen application from 0 to 500g N/tree, whereas it remained at par when tree received 500g N and 1000g N. Significant differences in plant height,

girth and spread were observed between trees receiving no nitrogen (212.2 cm, 28.5 cm and 296.9 cm respectively), and trees receiving 500g N and 1000g/N (258 cm, 34.6 cm and 358.5 cm; 261.5 cm, 35.8 cm and 369.9 cm) respectively.

In general, flowering was sparse due to less number of flowering panicles and lesser nut yield from all the treatments during the year due to climatic/ weather factors in entire Andhra Pradesh. The effect of higher doses of fertilizer was not observed (Table 2.1).

Table 2.1: Growth and yield parameters with higher dose of fertilizers at Bapatla.

Treatments	Girth (cm)	Canopy (m)	No. of flowering panicles/sq. m.	Yield/tree/year (kg)
T1 – 500 N, 125 P ₂ O ₅ and 125 K ₂ O	128.2	11.6	10.0	2.7
T2 – 1000 N, 250 P ₂ O ₅ and 250 K ₂ O	137.8	12.4	14.4	3.0
T3 – 1500N, 375 P ₂ O ₅ and 375 K ₂ O	131.0	12.1	14.8	2.9

Bhubaneswar:

Application of N, K₂O significantly increased the number of flowering panicles/sq. m over control. Maximum number (21.83) of panicles were recorded with 1000g N followed by 500g N (21.06)

and control (19.0) (Table 2.2). The interaction effect of NP, NK, PK and NPK on flowering panicles/sq. m was found non-significant.

Table 2.2 : Effect of NPK and their interaction on number of flowering panicles/m² at Bhubaneswar

Treatment	P0	P125	P250	Mean	K0	K125	K250
N0	18.67	19.00	19.33	19.00	18.33	19.17	19.50
N 500	21.17	20.67	21.33	21.06	20.00	20.83	22.33
N 1000	21.50	21.67	22.33	21.83	20.83	22.00	22.67
Mean	20.44	20.44	21.00		19.72	20.67	21.50
K0	19.83	19.67	19.67				
K125	20.50	20.33	21.17				
K250	21.00	21.33	22.17				
'F' test	N	P	K	NP	NK	PK	NPK
	SIG	NS	SIG	NS	NS	NS	NS

SE m ± for N/P/K = 0.26

SE m ± for NP/NK/PK = 0.45

SE m ± for NPK = 0.77

CD 5% for N & K = 0.76

CV = 5.31%

Interaction effects of NP, NK, PK and NPK on nuts/panicle, nut weight and nut yiela are presented in Tables 2.3, 2.4 and 2.5 respectively.

Table 2.3 : Effect of NPK and their interaction on number of nuts/panicles at Bhubaneswar.

Treatment	P0	P125	P250	Mean	K0	K125	K250
N0	5.43	5.58	5.70	5.57	5.32	5.48	5.92
N 500	5.78	6.12	6.65	6.18	6.05	6.10	6.40
N 1000	7.00	7.85	8.18	7.68	7.25	7.63	8.15
Mean	6.07	6.52	6.84		6.21	6.41	6.82
K0	5.53	6.33	6.75				
K125	5.97	6.50	6.75				
K250	6.72	6.72	7.03				
'F' test	N	P	K	NP	NK	PK	NPK
	SIG	SIG	SIG	SIG	NS	SIG	SIG

SE m ± for N/P/K = 0.07
 SE m ± for NP/NK/PK = 0.12
 SE m ± for NPK = 0.22
 CD 5% for N/P/K = 0.203; for NP/PK = 0.35; for NPK = 0.64
 CV = 4.72%

Table 2.4 : Effect of NPK and their interaction on nut weight (g) at Bhubaneswar.

Treatment	P0	P125	P250	Mean	K0	K125	K250
N0	4.32	4.43	4.43	4.39	4.28	4.40	4.50
N 500	4.55	4.55	4.55	4.55	4.45	4.57	4.63
N 1000	4.48	4.50	4.58	4.52	4.45	4.50	4.62
Mean	4.45	4.49	4.52		4.39	4.49	4.58
K0	4.38	4.38	4.42				
K125	4.45	4.48	4.53				
K250	4.52	4.62	4.62				
'F' test	N	P	K	NP	NK	PK	NPK
	SIG	NS	SIG	NS	NS	NS	NS

SE m ± for N/P/K = 0.021
 SE m ± for NP/NK/PK = 0.037
 SE m ± for NPK = 0.063
 CD 5% or N & K = 0.06; for NP/NK/PK = 0.11
 CV = 2.00%

Table 2.5 : Effect of NPK and their interaction on nut yield (kg/plant) at Bhubaneswar

Treatment.	P0	P125	P250	Mean	K0	K125	K250
N0	2.13	2.40	2.68	2.41	1.92	2.55	2.75
N 500	3.62	3.85	4.38	3.95	3.28	3.62	4.95
N 1000	5.90	6.20	6.43	6.18	5.67	5.85	7.02
Mean	3.88	4.15	4.50		3.62	4.01	4.91
K0	3.57	3.33	3.97				
K125	3.65	4.02	4.35				
K250	4.43	5.10	5.18				
'F' test	N	P	K	NP	NK	PK	NPK
	SIG	SIG	SIG	NS	SIG	SIG	NS
SE m ± for N/P/K = 0.07							
SE m ± for NP/NK/PK = 0.13							
SE m ± for NPK = 0.22							
CD 5% or N/P/K = 0.20; for NP/NK/PK = 0.38							
CV = 7.45%							

Chintamani :

The experiment was laid out in 1987 at Chintamani located in Maidan Region. The grafts of the variety Ullal-1 were used in the experiment and planted at a spacing of 7.5 m x 7.5 m. Plant height, stem girth and canopy spread did not differ significantly due to the levels of NPK and their interaction.

Plant height differed significantly with respect to PK interactions only. The highest plant height was recorded in trees received 250g of P and no K (4.96 M) followed by 250g of P and 125g of K (4.92 m) and they differed significantly with control (Table 2.6).

Table 2.6 : Effect of different levels of NPK and their interaction on plant height at Chintamani.

Treatment	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂
N ₀	4.63	4.70	4.75	4.69	4.57	4.75	4.76
N ₁	4.53	4.84	4.77	4.71	4.84	4.71	4.58
N ₂	4.43	4.69	4.81	4.64	4.73	4.78	4.42
Mean	4.53	4.74	4.78		4.71	4.75	4.58
K ₀	4.34	4.85	4.96				
K ₁	4.63	4.69	4.92				
K ₂	4.62	4.68	4.45				
N/P/K	±0.07	CD 5%=NS					
NP/NK	±0.12	CD 5%=NS					
PK	±0.12	CD 5%=0.47					

The NPK levels and their interactions did not influence the stem girth significantly (Table 2.7).

Table 2.7 : Effect of different levels of NPK and their interactions on stem girth (cm) at Chintamani.

Treatment	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂
N ₀	73.37	76.71	82.29	77.45	77.66	76.58	78.12
N ₁	74.54	78.08	78.79	77.14	79.00	79.12	73.29
N ₂	74.54	77.58	76.25	76.12	79.12	77.58	71.66
Mean	74.15	77.45	79.11		78.59	77.76	74.35
K ₀	74.71	80.04	81.04				
K ₁	76.21	77.71	79.37				
K ₂	71.54	74.62	76.91				
N/P/K	±1.42	CD 5%=NS					
NP/NK/PK	±2.46	CD 5%=NS					

The levels of NPK and their interaction influenced neither the E-W nor the N-S canopy spread (Table 2.8 and 2.9).

Table 2.8 : Effect of different levels of NPK and their interaction on cashew canopy spread(E-W) at Chintamani.

Treatment	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂
N ₀	8.12	8.37	8.29	8.26	8.21	8.21	8.38
N ₁	8.02	8.45	8.37	8.28	8.51	8.34	7.99
N ₂	8.00	8.08	8.22	8.10	8.42	8.16	7.72
Mean	8.05	8.30	8.29		8.38	8.23	8.03
K ₀	8.18	8.45	8.51				
K ₁	8.05	8.34	8.37				
K ₂	7.95	8.13	8.05				
N/P/K	±0.11	CD 5%=NS					
NP/NK/PK	±0.19	CD 5%=NS					

Table 2.9 : Effect of different levels of NPK and their interaction on cashew canopy spread (N-S) at Chintamani.

Treatment	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂
N ₀	7.86	8.28	8.41	8.18	8.22	8.08	8.33
N ₁	7.92	8.26	8.60	8.26	8.55	8.30	7.92
N ₂	7.98	8.16	8.33	8.16	8.33	8.18	7.96
Mean	7.92	8.23	8.45		8.37	8.17	8.07
K ₀	8.20	8.28	8.63				
K ₁	7.89	8.28	8.38				
K ₂	7.76	8.14	8.31				
N/P/K	±0.14	CD 5%=NS					
NP/NK/PK	±0.24	CD 5%=NS					

The influence of NPK levels and their interactions over seven years on nut yield revealed that the effect of NPK and their interactions were not consistent with their significant influence over years. When individual nutrient effects are considered, application of 500g N, 125g P₂O₅ or 250g K₂O/tree/year has increased the yield substantially over control. Among second order interactions, N₂P₂ (4.24 kg/tree) N₂K₂ (4.49 kg/tree) and P₂K₂

(4.75 kg/tree) recorded the highest seven years mean yield (Table 2.10). Among NPK interactions, the highest nutrient level combination i.e. application of 1000g N, 250g K₂O and 250 g P₂O₅ recorded the highest mean yield (5.49 kg/tree) followed by 500:250:250g NPK (5.18 kg/tree), 500:250:125g of NPK (5.00 kg/tree), 1000:125:250g of NPK (4.84 kg/tree) and 500:125:250g of NPK (4.45 kg/tree) which were all at par with each other (Table 2.11).

Table 2.10 : Main and interaction effects of NPK on cashewnut yield at Chintamani.

Main interaction effect	Nut yield kg/tree							Mean
	1991	1992	1993	1994	1995	1996	1997	
N0	2.23	0.70	2.58	3.09	4.93	1.65	2.35	2.50
N1	2.52	0.98	3.33	4.53	5.44	1.84	3.39	3.15
N2	2.86	0.75	3.18	6.38	6.41	2.41	3.78	3.68
F Test	**	*	NS	*	NS	*	*	
P0	1.92	0.74	2.52	4.47	5.12	1.56	2.65	2.71
P1	2.83	0.84	3.33	4.66	5.58	1.99	3.13	3.19
P2	2.86	0.86	3.24	4.88	6.09	2.36	3.74	3.43
F Test	**	NS	**	NS	NS	*	*	
K0	2.02	0.80	2.11	3.98	5.52	1.44	2.65	2.64
K1	2.63	0.76	4.42	4.34	4.74	1.86	3.03	3.11
K2	2.96	0.87	4.56	5.69	6.53	2.60	3.85	3.87
F Test	**	NS	**	*	NS	*	*	
NP Interaction								
N0P0	1.75	0.70	2.57	2.87	4.00	1.21	1.81	2.13
N0P1	2.43	0.68	3.02	3.94	5.35	1.71	2.54	2.81
N0P2	2.52	0.73	2.17	2.46	5.44	2.00	2.72	2.57
N1P0	1.75	0.80	2.51	5.01	5.13	1.36	2.57	2.73
N1P1	2.78	1.16	3.60	4.35	5.09	1.95	3.17	3.15
N1P2	3.03	1.00	3.88	4.24	5.50	2.22	4.44	3.47
N2P0	2.25	0.71	2.49	5.53	5.64	2.11	3.58	3.19
N2P1	3.30	0.68	3.39	5.68	6.28	2.31	3.68	3.62
N2P2	3.04	0.86	3.66	7.94	7.32	2.82	4.07	4.24
F Test	NS	NS	*	*	NS	NS	*	
NK interaction								
N0K0	1.81	0.64	2.01	3.01	4.15	1.26	1.99	2.13
N0K1	2.33	0.77	1.79	3.09	4.62	1.70	2.17	2.35
N0K2	2.56	0.70	3.96	3.15	6.01	1.99	2.90	3.04
N1K0	2.02	1.11	2.00	3.88	6.32	1.37	2.76	2.78
N1K1	2.58	0.85	2.58	4.39	3.05	1.73	3.18	2.67
N1K2	2.96	1.00	5.10	5.33	6.95	2.42	4.24	4.00
N2K0	2.23	0.65	2.32	5.03	6.08	1.59	3.19	3.01
N2K1	3.00	0.67	2.59	5.53	6.53	2.15	3.74	3.49
N2K2	3.37	0.94	4.63	8.60	6.63	3.40	4.40	4.49
F Test	**	NS	NS	*	*	NS	NS	
PK interaction								
P0K0	1.90	0.90	1.57	4.51	6.14	1.31	2.33	2.66
P0K1	1.83	0.49	2.37	4.55	5.09	1.57	2.66	2.65
P0K2	2.02	0.82	3.63	4.34	4.13	1.78	2.96	2.81
P1K0	1.88	0.84	2.27	3.65	5.55	1.35	3.14	2.67
P1K1	2.96	0.82	2.71	4.24	4.30	1.94	3.14	2.87
P1K2	3.66	0.86	5.03	6.08	6.89	2.67	3.10	4.04
P2K0	2.28	0.66	2.50	3.77	4.86	1.67	2.47	2.60
P2K1	3.11	0.98	2.19	4.22	4.85	2.07	3.28	2.95
P2K2	3.21	0.95	5.03	6.65	8.58	3.34	5.47	4.75
F Test			NS	*	NS	*	*	
SE m ±								
NPK	0.05	0.06	0.16	0.20	0.72	0.13	0.25	
NP/NK/PK	0.08	0.18	0.27	0.35	0.84	0.18	0.74	
CD 5%								
N/P/K	0.14	0.11	0.46	0.59	NS	0.37	0.72	
NP/NK/PK	0.24	0.31	0.70	1.02	2.17	0.52	2.15	

Table 2.11 : Effect of different combinations of NPK on yield of cashewnut at Chintamani.

Treatment combinations	Yield kg/tree							Mean
	1991	1992	1993	1994	1995	1996	1997	
000	1.39	0.86	1.16	2.24	2.99	0.79	1.17	1.51
001	1.65	0.56	2.18	2.72	4.85	1.41	2.25	2.23
002	2.20	0.68	4.87	3.64	4.18	1.42	2.00	2.71
010	1.65	0.46	2.55	4.05	5.48	1.25	3.61	2.72
011	2.33	0.92	2.16	4.73	5.94	1.69	2.30	2.87
012	3.28	0.67	4.34	3.03	4.64	2.19	1.70	2.84
020	2.39	0.60	2.32	2.76	3.98	1.74	1.20	2.14
021	2.99	0.83	1.53	1.83	3.15	1.99	1.95	2.04
022	2.19	0.75	2.67	2.78	9.23	2.36	5.00	3.57
100	1.95	1.00	1.78	5.74	4.78	1.28	2.71	2.75
101	1.72	0.45	3.60	6.06	3.31	1.36	2.10	2.66
102	2.42	0.86	2.14	3.22	2.16	1.43	2.90	2.16
110	1.90	1.57	1.89	2.47	4.96	1.28	2.67	2.39
111	2.95	0.93	2.60	3.65	3.02	2.06	3.20	2.63
112	3.48	0.98	6.31	6.94	7.31	2.51	3.64	4.45
120	2.21	0.77	2.35	3.43	4.45	1.55	2.91	2.52
121	3.07	1.17	2.45	3.45	2.84	1.78	4.22	5.00
122	3.82	1.05	6.84	5.83	9.21	3.32	6.18	5.18
200	2.35	0.86	1.78	5.55	5.88	1.88	3.10	3.06
201	2.13	0.47	1.82	4.87	7.12	1.93	3.63	3.14
202	2.27	0.84	3.88	6.17	3.90	2.50	4.00	3.37
210	2.09	0.50	2.37	4.44	6.21	1.51	3.15	2.90
211	3.60	0.62	3.38	4.33	3.91	2.09	3.92	3.12
212	4.21	0.93	4.44	8.28	8.73	3.34	3.97	4.84
220	2.24	0.61	2.82	5.10	6.14	1.70	3.30	3.13
221	3.26	0.93	2.58	7.37	4.27	2.43	3.66	3.50
222	3.61	1.05	5.59	11.34	7.27	4.36	5.23	5.49
Mean	2.57	0.81	3.05	4.67	5.18	1.99	3.06	
Years	SEM±	0.21	CD 5%	0.61				
Treatments	SEM±	0.40	CD 5%	1.16				

Madakkathara:

Observations on tree height, girth and canopy spread were recorded four months after imposing treatments. The data indicated that N2P0K1 resulted in maximum tree height (4.7 m) whereas minimum tree height was observed for

N0P1K2. Maximum girth of trees was obtained for N2P0K0 and N2P1K2 applications. Maximum canopy spread was observed in N0P0K1 at Madakkathara.

Table 2.12 : NPK Experiment - Growth characters recorded during January 1999
(Year of Planting - September 1992)

Treatment	Height (m)	Girth (cm)	Canopy spread (m)
N0P0K0	4.2	47.0	4.45
N0P0K1	4.5	45.0	5.51
N0P0K2	3.9	48.3	4.35
N0P1K0	4.2	45.0	4.62
N0P1K1	4.2	46.0	4.9
N0P1K2	3.8	49.8	4.73
N0P2K0	4.3	54.5	4.88
N0P2K1	4.2	60.5	5.02
N0P2K2	4.4	50.4	4.86
N1P0K0	3.9	58.8	5.36
N1P0K1	4.2	51.5	4.97
N1P0K2	4.5	49.5	4.84
N1P1K0	4.2	45.5	4.19
N1P1K1	4.0	52.4	4.09
N1P1K2	4.3	57.8	5.13
N1P2K0	4.4	54.5	4.44
N1P2K1	4.4	51.5	5.08
N1P2K2	4.3	56.3	5.03
N2P0K0	4.9	61.0	5.19
N2P0K1	4.7	52.8	4.99
N2P0K2	4.5	55.7	5.12
N2P1K0	4.2	50.8	4.84
N2P1K1	4.8	61.0	5.14
N2P1K2	3.9	38.8	4.49
N2P2K0	4.4	55.8	4.5
N2P2K1	4.3	51.0	4.92
N2P2K2	4.6	52.4	4.07

The data recorded from on farm trial in cashew at Madakkathara in farmers field which is given below in Table 2.13.

Table 2.13 : Mean height, girth, canopy spread and yield.

Treatment	Height (m)	Girth (cm)	Canopy spread (m)	Yield (g/tree)
T1	4.0	52.9	4.86	187.50
T2	5.0	53.6	5.88	416.70
T3	4.7	54.3	5.67	237.50

Plant growth measured in terms of height, girth and canopy spread as well as nut yield did not increase substantially beyond the fertiliser dose of T2 (i.e. 1125-500-1125 (g) of N, P₂O₅ and K₂O).

Vengurle:

The yield is very poor due to

of grafts. From this year onwards, this practice will be stopped.

Under on farm fertilizer trial for maximisation of yield in cashew at Vengurle, one hundred trees of V-4 and V-1 variety were planted for fertilizer trial in two farmers' fields and the trees are yet to yield (Table 2.14).

Table 2.14 : Growth and yield parameters under NPK trial at Vengurle

Treatments	Height (m)	Girth (cm)	Canopy Spread		Yield (kg/tree)
			E-W	N-S	
N0P0K0	2.55	31	2.62	2.78	0.435
N0P0K1	2.70	31	2.76	3.02	0.895
N0P0K2	2.53	27	2.46	2.63	0.575
N0P1K0	2.75	29	2.54	2.44	0.625
N0P1K1	2.58	28	2.38	2.55	1.017
N0P1K2	2.75	35	2.76	2.63	1.555
N0P2K0	2.71	31	2.74	2.58	1.150
N0P2K1	2.85	34	3.31	3.33	1.195
N0P2K2	2.52	28	2.42	2.61	0.980
N1P0K0	2.71	38	2.93	2.75	1.860
N1P0K1	2.57	29	2.68	2.73	1.920
N1P0K2	2.69	29	2.51	2.75	1.310
N1P1K0	2.89	34	3.09	3.62	3.600
N1P1K1	2.82	33	3.03	3.21	1.635
N1P1K2	2.75	38	3.56	3.22	1.825
N1P2K0	3.09	34	3.04	3.41	2.250
N1P2K1	2.72	35	3.20	3.42	1.590
N1P2K2	3.01	40	3.65	3.77	3.360
N2P0K0	2.56	33	3.63	3.37	1.300
N2P0K1	2.31	30	2.60	2.85	2.230
N2P0K2	2.85	30	2.70	2.81	2.000
N2P1K0	2.88	35	3.30	3.23	2.830
N2P1K1	3.31	39	3.82	4.34	2.405
N2P1K2	2.76	32	3.21	3.15	2.060
N2P2K0	2.89	36	3.84	3.38	2.865
N2P2K1	2.93	42	3.89	3.44	2.600
N2P2K2	2.79	32	3.21	3.07	2.450

Project Title : Agr. 4 : Spacing trial.

Centres:

East Coast : Jhargram

West Coast : Vengurle

The preliminary results on the density of planting per unit area at Jhargram showed that maximum yield per block was obtained in 6x6x6m triangular planting whereas 5 m x 5 m was found to be yielding highest at Vengurle. However, these results may have to be continued further to obtain appreciable results.

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

Design	:	RBD
Replication	:	3
Plot size	:	25m x 25m
Area covered	:	2.25 ha
Variety	:	Red Hazari (Jhargramn), V-4 (Vengurle)
Year of planting	:	July 1982 (Jhargram), July 1990 (Vengurle)

Different spacing trials:

T1	5m x 5m	:	Square with no thinning
T2	5m x 5m	:	Square with thinning of 50% plants (after 6 years in 1990)
T3	5m x 5m	:	Square with thinning of 75% plants (after 11 years)
T4	10m x 5m	:	Rectangular
T5	10m x 5m	:	Rectangular with thinning of 50% plants (after 6 years, done in 1990)
T6	10m x 10m	:	Square
T7	10m x 10m x 10m	:	Triangular
T8	8m x 8m	:	Square
T9	8m x 8m x 8m	:	Triangular
T10	6m x 6m	:	Square
T11	6m x 6m x 6m	:	Triangular
T12	5m x 5m	:	Square with selective thinning of 50-75% plants. During 1990, 50% plants were removed selectively.

Jhargram:

Maximum number of nuts (554) per plant was observed in (10m x 10m) rectangular system followed by 541 nuts per plant in 6m x 6m square system of planting (Table 2.14). Maximum yield per block (43.34 kg) was noted in 6m x

6m x 6m triangular system of planting followed by 38.40 kg in 6m x 6m square system of planting with no thinning. Minimum yield per block was recorded in 10 m x 5m rectangular system with 50% thinning of plants (9.28 kg).

Table 2.15 : Yield performance of cashew at different spacings at Jhargram.

Treatments	No. of trees/block	Canopy	No. of nuts/tree	Yield/tree/Year	Yield/block (kg/block)	Cumulative yield (1988-98)
T1	25	Medium	263	1.12	28.00	495.04
T2	13	"	327	1.36	17.68	262.95
T3	25	"	230	0.95	23.75	413.04
T4	8	"	394	2.05	16.40	274.31
T5	4	"	437	2.32	9.28	119.95
T6	4	"	554	2.36	9.44	84.75
T7	7	"	521	2.15	15.05	146.36
T8	9	"	500	2.40	21.60	--
T9	12	"	406	1.89	22.68	315.43
T10	16	"	541	2.45	38.40	478.94
T11	22	"	450	1.97	43.34	500.23
T12	13	"	287	1.22	15.86	276.03
CD 5%			7.57	0.065		

Vengurle:

Results revealed that there were no significant differences in plant height, girth and tree canopy. However, crowding of tree canopy was observed in T1, T2 and T3 (400 trees/ha.). Therefore as per the treatments details 50% plants will be removed immediately from T-2,

T-3 and T-5. The yield in treatments T-1, T-2 and T-3 were 958, 884 and 895 kg nuts/ha, respectively (Table 2.16). The yield obtained at a spacing of 5m x 5m was found to be maximum per unit area among the treatments

Table 2.16 : Growth and yield of cashew at different spacings at Vengurle

Treatments	Height (m)	Girth (cm)	Canopy spread		Yield kg/tree	Yield per ha. (kg/ha)	No. of trees/ha
			E-W	N-S			
T1	3.16	39	3.64	3.57	2.394	958	400
T-2	3.31	39	3.63	3.69	2.210	884	400
T-3	3.14	39	3.67	3.4	2.237	895	400
T-4	3.04	37	3.54	3.54	1.863	373	200
T-5	2.93	36	2.63	3.49	2.142	428	200
T-6	3.10	35	2.84	3.39	1.806	186	100
T-7	2.84	32	3.16	3.16	1.887	217	115
T-8	3.12	40	3.50	3.49	2.308	360	156
T-9	3.04	33	2.97	2.97	2.250	412	180
SEm±	0.126	2.071	0.214	0.224	0.147	--	--
CD 5%	NS	NS	NS	NS	NS		

Project Title : Agr. 6 : Cashew based cropping system.

Centres:

East Coast : Bapatla, Bhubaneswar, and Vridhachalam

West Coast : Madakkathara

Cowpea inter-crop was found enterprising as mixed crop in cashew plantations at Bhubaneswar and Jhargram while groundnut was found profitable at Vridhachalam. Bitter gourd was found to be highest yielding inter crop at Vengurle.

The objectives are to:

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

Main plot : 4
Sub-plot -3 : 3
No. of replications : 3
Design : Split plot

Sub-plot:

- FO - No additional fertilizer to inter-crop
- F1 - Additional fertilizer application to the inter-crops as per the state recommendation.
- F2 - 50% of the additional fertilizer application to the inter-crop.

Bapatla:

Treatments: (Main Plot)

- T1 Cashew main crop
- T2 Cashew + Sesame
- T3 Cashew + Horsegram
- T4 Cashew + Blackgram

This trial is in progress in an area of 1 acre.

Bhubaneswar:

Treatments:

- T1 Cashew (main crop)
- T2 Cashew + Cowpea
- T3 Cashew + Snake gourd
- T4 Cashew + Pumpkin
- T5 Cashew + Ash gourd

T6 Cashew + Sponge gourd

T7 Cashew + Bottle gourd (Lauki)

The inter-crops were grown during kharif 1998. The cashew plants were applied with recommended doses of fertilizers (500:125:125 g/plant/year NPK). Recommended fertilizers were applied to the inter-crops. Before growing for inter-crops the cashew plants were pruned properly and 2.0 m was left from the base of the cashew plants and inter-crops were raised in the pits and cowpea was sown in lines. The average yield of cashew and inter-crops and their prevailing prices are as follows (Table 2.17) :

Table 2.17 : Performance of cashew and inter-crops at Bhubaneswar.

Cropping System	Yield (kg)	Market price (Rs./q)		
		Cashew	Inter-crop	Average income/ha
Cashew	8.77	3500	--	30,666.70
Cashew + cowpea	9.73 + 25	3500	160	38,066.70
Cashew + Snake gourd	8.95 + 41.7	3500	100	35,466.70
Cashew + Pumpkin	8.50 + 46	3500	100	34,361.70
Cashew + Ash gourd	8.23 + 22.7	3500	70	31,570.00
Cashew + Ridge gourd	8.93 + 16.3	3500	120	33,226.70
Cashew + Bottle gourd	8.95 + 60	3500	50	34,325.00
SE m ±				1,154.59
CD 5%				3,559.00

Jhargram:

Treatments:

T1 Cashew (main crop)

T2 Cashew + Groundnut

T3 Cashew + Cowpea

Inter-cropping in cashew seedling based system with groundnut inter-crop yielded 150 kg/ ha of ground nut and with cowpea yielded 494 kg/ha of cowpea and the results were found encouraging during the initial stages of establishment of cashew plantations.

Vridhachalam:

Treatments:

T1 Cashew (main crop)

T2 Cashew + Black gram

T3 Cashew + Sesame

T4 Cashew + Groundnut

T5 Cashew + Cowpea

The yield recorded was 275, 588, 125 and 425 kg/ha for blackgram, groundnut, sesame and cowpea (Table 2.18). The performance of groundnut was found good. The East-West and North - South plant spread and girth (20-28 cm) of cashew was more in cashew - groundnut inter-cropping. The seedling height ranged between 220 - 240 cm. The Sesame plant height was 74.7 cm and blackgram was 22.2 cm.

Table 2.18 : Performance of inter-crops in cashew based cropping system at Vridhachalam

Treatment	Performance of cashew				Performance of Inter-crop				
	Tree height (cm)	Tree girth (cm)	Canopy spread		Yield (kg)	Root depth (cm)	Stem girth (cm)	Canopy (cm)	Plant height (cm)
			E-W	N-S					
Cashew + Blackgram	240	250	1.9	1.9	275	11.9	1.8	11.4	22.2
Cashew + Cowpea	230	23.0	2.1	2.2	425	10.3	2.4	28.0	54.7
Cashew + Sesame	220	20.0	1.8	1.9	125	10.6	3.1	19.1	74.7
Cashew + Groundnut	240	28.0	2.2	2.2	588	13.3	1.5	21.2	32.9
Control	220	20.0	2.0	1.9	-	-	--	--	--

Madakkathara:

The following were the inter-crop treatments.

T1 Cashew alone

T2 Cashew + Adathoda

T3 Cashew + Colaesus

Adathoda beddomei, Acanthaceae (economic part - whole part) and

Colaesus zeylanicus, Lamiaceae (economic part - dried stem).

The cuttings of the medicinal plants were planted on ridges and raised under rainfed conditions and 25 kg/plot farmyard manure was applied. By adopting gap filling, the plant population was regulated. Both Adathoda and Colaesus did not grow well in the cashew

plantations due to severe drought during the cropping period.

Vengurle:

Treatments:

T1 Cashew (main crop)

T2 Cashew + Ridge gourd

T3 Cashew + Bitter gourd

T4 Cashew + Cucumber

T5 Cashew + Okra

T6 Cashew + Vegetable cowpea

The vegetable crops as mentioned above were taken up in kharif 1998 season as inter-crop with cashew and data was collected. The data so collected shows that growing vegetables as inter crop with cashew was found profitable (Table 2.19).

Table 2.19 : Yield of vegetable crops as inter-crop with cashew at Vengurle

Name of Inter-crop	Plot size (sqm)	Yield (kg)	Yield per ha. (kg)
Bitter gourd	40	40	10000
Ridge gourd	195	161.45	8279
Cucumber	150	133.75	8917
Okra	400	197.200	4607
Cowpea	150	28.100	2540

Project Title : Agr. 7 : Drip irrigation trial

Centres:

East Coast : Vridhachalam

West Coast : Vengurle

Maidan tract : Chintamani,

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

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

Chintamani:

Planting of 240 grafts of Chintamani-1 has been done during September 1997. The establishment of plants is quite satisfactory.

Vengurle:

This trial has been laid out at

Agricultural Research Station, Mulde, Kudal, and Sindhudurg District. Soft wood grafts of Vengurla-7 were planted at a spacing of 7 m x 7 m for the purpose of implementing the trial.

Project Title : Hort. 2 : Rootstock - scion interaction studies in cashew:

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam.

West Coast : Madakkathara, Pilicode, Vengurle

Maidan tract : Chintamani

The objective of the experiment is to study the influence of root stock or interstock on the growth of the scion variety and to select root stock or interstock which induces dwarfing or semi-tall growth habit to the grafted plant (scion variety).

Technical Programme:

- (a) Number of root stocks : 3
- (b) Number of interstocks : 1
- (c) Number of scion varieties : 2

At Bapatla, this trial was initiated in 1998. Single graft (>100) of VRI-2 on VRI-2 and VRI-3 on BPP 5 were produced.

At Bhubaneswar, during the year seeds of cashew type M 44/3, M 26/2 and Bhubaneswar-1 were collected and seedlings were raised in polythene bags 25 cm x 10 cm. M 44/3 scion sticks were grafted on rootstocks of M 44/3. M 26/2 and Bhubaneswar-1 during August 98. H 2/16 (BPP - 8) scion sticks were double grafted in M 44/3, M 26/2 and local root stocks.

At Jhargram, the trial was laid out in 1988 and the experiment is in initial stages.

At Madakkathara, Grafts of the following root stock scion combinations were made and kept for double grafting as well as and for further evaluation.

Root Stock	Inter Stock	Scion variety
M 44/3	M 44/3	Dhana
M 26/2		Priyanka
Anakkayam-1		

The following number of grafts are being kept in the green house for double grafting and for further evaluation.

Variety	Number of grafts in green house
M 44/3 x Dhana	36
M 44/3 x Priyanka	31
M 26/2 x Dhana	48
M 26/2 x Priyanka	39
Anakkayam-1 x Dhana	39
Anakkayam-1 x Priyanka	30

At Vengurle, The double grafts have been made and the success percentage ranged between 40-50% in the following:

Rootstock	Inter-stock	Scion
M 44/3	M 44/3	M 26/2
M 26/2		M 44/3

Studies on rootstock - scion interaction in the above centres are in progress and are in the initial stages.

B. HORTICULTURE

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

Centres:

East Coast : Bapatla and Bhubaneswar

West Coast : Madakkathara and Vengurle

Six dwarf types at Bapatla, one semi dwarf at Bhubaneswar, 10 less vigourous and five vigourous types at Madakkathara and 15 types at Vengurle were under evaluation during the current year.

The objective of the trial is to identify dwarfing rootstocks at nursery stage based on morphological, anatomical, physiological characters viz. height, girth, number of stomata, bark percentage and phenolic contents.

Bapatla:

The seedling growth of 6 dwarf trees were studied along with BPP 5 for height, number of leaves, stem girth and internodal length in polybags.

Bhubaneswar:

One semi dwarf type was identified. The grafted materials prepared during 1998 was planted in the field for further studies.

Madakkathara:

Seeds collected from 10 less vigorous types and 5 vigorous types were utilised for the study (Table 2.20). During August 1992, two dwarf and vigorous types (T.No.2286 and Kariyarappatta) were identified and their seedlings were planted in the field for further evaluation.

Table 2.20 : Growth characters of plants (New Brazil collection) during 1997 to 98 at Madakkathara.

Variety. No	Height (m)	Girth (cm)	Spread		No. of Pr. Branches
			E-W	N-S	
B2	4.2	65	5.1	5.2	2
B3	4.0	51	3.5	3.8	2
B4	5.8	60	3.5	4.2	2
B5	4.1	48	3.2	3.5	2
B6	5.8	48	4.9	5.2	2
B7	5.8	60	4.3	4.9	2
B9	3.1	40	2.9	3.0	3
B10	5.6	55	5.3	4.3	5
B11	5.6	65	3.9	4.2	2
B12	5.2	55	3.8	4.3	2
B13	3.5	35	1.8	2.1	--
B14	3.8	34	2.4	1.8	3
B15	4.5	41	2.9	2.5	2
B16	4.8	52	4.3	3.9	2
B17	3.8	51	2.8	2.9	3
B18	5.4	58	4.6	4.8	2
B19	2.8	35	2.3	2.9	--
B20	2.5	25	1.6	1.6	--

Vengurle:

The seedlings raised from seed nuts of dwarf and vigorous growing trees were screened for morphological and anatomical characters at nursery stage. The rootstocks did not show much

different in height and girth (Table 2.21). Hence selfing has been done in all the types and seedlings are raised for recording observations.

Table 2.21 : Screening of rootstock for dwarfing characters in selfed seedlings at Vengurle.

Rootstock variety	Growth observations in 45 days old seedlings		
	Height (cm)	Girth (cm)	No. of leaves/seedling
V-1	26	2.68	11
V-2	19	2.35	10
V-3	23	2.43	09
V-4	29	2.66	12
V-5	26	2.20	9
M 44/3	26	2.90	11
H-1600	25	2.95	09
VTH 59/2	29	3.24	11
H-2/16	27	2.95	12
T-129	17	2.48	11
H-1600	27	2.70	12
H-1610	24	2.30	11
VTH 30/4	19	2.60	11
M 26/2	25	2.82	11
H 2/15	22	2.55	11

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

The recommended spraying of monocrotophos 0.05%, endosulfan 0.05% and carbaryl 0.1% at flushing, flowering and fruiting stages reduced percentage of insect infestation at all the Centres.

The project is aimed to find out an effective spray schedule for the management of tea mosquito bug and other minor pests of cashew. This

project also aims at testing the efficacy of certain plant products in comparison with standard insecticidal spray schedule against pests of cashew.

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

Centres:

East Coast : Bhubaneswar, Jhargram, Vridhachalam

West Coast : Madakkathara, Vengurle

Maidan tract : Jagdalpur, Chintamani

Treatments:

T1 : Monocrotophos (0.05%) one spray at flushing

T2 : Endosulfan (0.05%) one spray at flowering

T3 : Carbaryl (0.1%) one spray at fruiting

T4 : T1 and T2

T5 : T1, T2, and T3

T6 : T1 and T3

T7 : T2 and T3

T8 : Endosulfan (0.05%) at flowering stage followed by neem oil (2%)

T9 : Carbaryl (0.1%) at flowering stage followed by neem oil (2%) at fruiting stage

T10 : Control

The insecticidal treatments were given as indicated above and damage recorded one month after last spray at Bapatla is presented in Table 3.1. The results available from three centres (Chintamani, Jagdalpur and Jhargram) revealed that the extent of tea mosquito bug damage was very low. The skipping third spray at fruiting (T-4) was found economical at Jhargram centre as yield was equal to T-5.

Among them, T5 treatment had shown least damage and registered increased yield. Even though, insecticidal treatments caused considerable depression in predator population, they had not eliminated them completely.

Bapatla:

Pests recorded during the season are:

Leaf and blossom webber - *Lamida monocusalis* wlk.

Leaf miner - *Acrocercos syngamma*
Meyrick

Shoot tip and inflorescence
caterpillar - *Hipotima haligamma*

Leaf folder - (a) *Caloptilea tiselea*,
(b) *Dudua aprobola*

Myllocerus sp.

Among all the treatments tried in
the trees which received three sprays,
first with Monocrotophos 0.05%, second

with Monocrotophos 0.05% and third
with Carbaryl 0.1% recorded minimum
percent infestation of *Myllocerus* sp. and
Hipotima haligamma during foliage
followed by maximum percent reduction
in damaged nuts by *Lamida moncusalis*,
which reflected in recording maximum
yields/tree. However, the incidence of
mealy bugs and Aphids was observed in
the panicles and nuts.

Table 3.1: Incidence of TMB in response to different pesticide treatments at Bapatla.

Treatments	I. Post treatmental counts (February 1998)					II. Post treatmental counts (March 1998)					Yield Kg./tree		
	L.m %	L.f %	H.h.	L.w.	L.m%	L.f %	H.h.	L.w.	L.f. %	H.h.		L.w.% nuts damaged	L.w. % nuts damaged
T1	5.8	22.12	1.00	1.15	3.00	16.10	0.75	0.50	15.00	1.00	5.25	18.30	6.230
T2	4.50	25.10	1.66	1.00	3.00	22.10	1.66	0.00	18.10	1.50	3.50	12.50	6.233
T3	2.00	30.40	1.00	2.25	3.15	30.75	1.50	2.00	28.50	1.50	2.85	6.00	10.00
T4	5.20	22.06	2.50	1.20	3.00	18.15	2.00	0.50	12.00	1.25	2.80	8.50	9.250
T5	8.50	22.75	0.50	0.50	2.65	16.50	0.00	0.00	8.25	0.0	4.50	9.25	17.500
T6	6.50	15.10	0.55	2.25	5.25	6.00	0.50	1.25	2.75	0.75	5.25	13.50	5.250
T7	12.00	28.50	0.10	0.30	13.50	28.00	0.50	0.50	24.50	0.50	2.75	10.50	12.550
T8	4.00	25.05	0.95	1.00	6.50	29.10	1.00	1.00	25.50	0.75	2.50	12.25	10.450
T9	6.80	20.40	1.00	0.50	7.80	21.50	1.50	0.75	19.50	1.00	2.75	9.785	12.750
T10	9.00	22.50	1.80	1.00	14.50	30.10	2.00	2.50	30.50	2.25	3.50	18.50	5.100

L.f = Leaf folder; L.m. = Leaf miner; H.h. = *Hipotima haligramma*; L.w. = Leaf Webber

Chintamani:

Incidence of TMB and natural enemies were recorded before and 30 days after each spray. At flushing and flowering the trees which have received sprays were least damaged and the incidences were very low. The affected trees put forth very few panicles because of shoot damage. The panicles were damaged and dried up due to cold injury during January. In the spray given at 30

days after third spray, plants received third spray have recorded least incidence of TMB. The lowest being in T5 (0.79 %) followed by T6, T3 and T7 which were at par with each other and differed significantly with other treatments (Table 3.2). The natural enemies population was highest in control (2.36/0.5 sq.m).

Table 3.2: Incidence of TMB in response to different pesticide treatments at Chintamani.

Treatment	Per cent TMB incidence				No. of Natural enemies*			Yield kg/tree**
	Pre-treatment	30 days after I spray	30 days after II spray	30 days after III spray	I	II	III	
T1	2.10	0.64	21.24	10.17	1.32	2.86	1.08	0.120
T2	2.13	29.90	5.09	10.41	4.18	2.03	1.26	0.427
T3	2.11	30.05	39.27	1.84	4.26	4.98	1.83	--
T4	1.93	0.65	0.53	10.09	0.98	0.36	1.26	0.221
T5	2.04	0.63	0.55	0.79	1.02	0.24	1.16	1.467
T6	1.89	0.64	21.38	1.72	0.72	2.46	1.31	0.221
T7	2.57	30.53	5.04	2.29	3.84	0.78	1.02	--
T8	2.19	30.02	5.90	8.63	4.11	1.48	1.65	--
T9	2.14	29.95	6.99	8.87	3.26	0.96	1.36	0.110
T10	1.88	30.52	41.42	14.63	3.98	6.11	2.36	--
SEM±	0.25	1.33	0.94	0.48				
CD5%	NS	4.25	3.01	1.53				
CV %	37.79	22.95	20.13	21.97				

* Only predators have been included

** Analysis was not carried out because of poor yield.

Jagdalspur:

Among all the treatments, T5 i.e. Monocrotophos 0.05% at flushing + Endosulfan 0.05% at flowering +

Carbaryl 0.1% at fruiting stage gave maximum yield with less incidence of pests followed by T9 and T4 (Table 3.3).

Table 3.3: Incidence of TMB in response to different pesticide treatments at Jagdalspur.

Treatment	Per cent flower damage by TMB	Per cent leaf damage by TMB	Per cent leaf damage by leaf miner	Per cent leaf damage by cater pillar	Per cent leaf damage by leaf roller	Yield/tree (Kg)
T1	7.27	5.39	5.39	6.23	11.81	3.22
T2	9.31	8.52	6.23	9.63	6.17	2.60
T3	16.13	9.42	13.66	11.03	5.39	3.15
T4	17.89	8.27	4.03	10.06	6.12	4.66
T5	7.90	6.16	5.94	8.05	3.38	7.69
T6	12.86	3.90	13.26	17.14	14.07	3.1
T7	11.38	4.73	7.05	11.65	5.07	3.4
T8	10.93	11.03	7.82	13.92	10.25	2.58
T9	20.11	9.80	10.75	11.88	5.97	5.41
T10	22.91	12.21	6.97	12.51	15.99	2.53

Jhargram:

The observations revealed that T1, T4, T5 and T6 were significantly superior to all other treatments after first spray. The mean incidence of TMB was 1.0, 0.98, 0.97 and 0.99 percent respectively (Table 3.4). It could be found during subsequent observations that more or less same trend was maintained. After second spray the mean incidence of TMB was 1.35, 1.37 in T4 and T5 respectively. After the third

spray, the mean incidence of TMB was 2.04 and 2.08 percent in T4 and T5 respectively. Maximum yield could be recorded in T4 and T5 followed by T6. Highest nut yield was 2.70 kg/tree in T4, 2.69 kg/tree in T5 as compared to 1.43 kg/tree in control (Table 3.4). It may be mentioned that T4 i.e. one round of spray during flushing stage and one round of spray during flowering stage is more beneficial from the cost benefit ratio.

Table 3.4: Incidence of Tea mosquito in response to different pesticide treatments at Jhargram

Treatments	Average percent of damage			Yield kg/tree
	First spray	Second spray	Third spray	
T1	1.0	2.5	4.8	1.87
T2	1.92	2.8	5.6	1.85
T3	2.1	4.2	6.9	1.66
T4	0.98	1.35	2.04	2.70
T5	0.97	1.37	2.08	2.69
T6	0.99	2.7	4.22	2.20
T7	2.21	2.9	4.82	1.91
T8	1.83	3.1	5.1	2.05
T9	2.04	3.4	6.2	1.99
T10	2.2	4.9	8.14	1.43
CD 5%	0.11	0.098	0.08	0.035

Madakkathara:

The most effective treatment was found to be T7 where the incidence of tea mosquito on panicle and nut was very low followed by T5 treatment (Table 3.5 and 3.6). The incidence of infestation by

minor pests like leaf miner, leaf roller, leaf and blossom webber was also very low in T7 treatment followed by T6 treatment. In the case of thrips, the lowest infestation was in T7 followed by T5.

Table 3.5 : Incidence of Tea mosquito bug (TMB) in response to different pesticide treatments at Madakkathara

Treatments	Pre-treatment (%)		After 2 nd spray (%)		After 3 rd Spray (%)		Yield kg/tree
	Shoot	Panicle	Panicle	Nut	Panicle	Nut	
T1	Skipped the spray						
T2	14.25	18.82	24.65	18.35	28.75	24.74	4.70
T3	20.49	23.43	18.81	22.66	30.67	30.65	3.65
T4	21.76	25.45	30.67	20.65	35.45	38.79	4.25
T5	13.62	17.52	17.13	17.13	30.00	32.47	5.10
T6	20.53	19.23	24.50	24.52	32.65	34.55	2.60
T7	11.83	16.33	17.00	17.65	29.33	30.09	5.65
T8	16.85	18.67	18.05	18.65	33.45	34.12	3.68
T9	20.49	20.54	22.69	24.15	35.62	39.14	4.00
T10	21.56	23.89	30.73	27.80	38.78	44.67	3.20
CD 5%	4.76	3.05	3.65	2.69	15.75	12.09	2.11

Table 3.6 : Incidence of Tea mosquito bug (TMB) indicated by scores.

Treatments	After 2 nd spray		After 3 rd spray	
	Panicle	Nut	Panicle	Nut
T1	--	--	--	--
T2	0.67	0.30	0.73	1.40
T3	0.58	0.40	0.45	1.30
T4	0.60	0.43	0.98	2.65
T5	0.39	0.28	1.00	0.98
T6	0.47	0.52	0.87	1.05
T7	0.32	0.22	0.40	1.00
T8	0.50	0.33	0.90	0.89
T9	0.42	0.30	0.83	1.21
T10	0.75	0.61	1.06	1.87
CD 5%	0.23	0.15	1.11	0.89

Vengurle:

Thirty days after first trial only T-1 and -5 were at par with each other and were found significantly superior over control. 30 days after 2nd spray, except T-6, rest of the treatments were

significantly superior over control. From this, it can be concluded that T-5 is the most effective treatment for the control of TMB (Table 3.7).

Table 3.7 : Incidence of TMB at Vengurle in response to different insecticide treatments.

Treatment	Damage after 30 days of		
	1 st Spray	2 nd Spray	3 rd Spray
T1	10.10	19.13	24.37
T2	15.22	19.07	25.11
T3	17.81	20.83	23.76
T4	10.87	16.46	20.74
T5	11.97	15.25	17.35
T6	14.61	22.22	24.37
T7	14.71	18.95	23.54
T8	18.67	20.69	23.74
T9	15.20	19.23	24.12
T10	21.13	28.32	33.73
SEM±	2.50	1.44	1.17
CD 5%	7.42	4.28	3.45

Vridhachalam:

Most effective treatment against the control of TMB at the centre was T5

followed by T7 (Table 3.8).

Table 3.8 : Incidence of TMB in insecticidal treatments of cashew at Vridhachalam

Treatment	Pretreatment count	TMB population per quadrant			Mean of 3 observations	Yield (Kg/tree)
		1 st Spray	2 nd Spray	3 rd Spray		
T1	1.5	0.75	0.60	0.70	0.683	2.60
T2	0.0	0.70	0.82	0.60	0.706	2.27
T3	1.0	1.00	0.75	0.70	0.816	3.15
T4	1.0	1.00	0.80	0.65	0.816	3.00
T5	1.5	0.0	0.50	0.50	0.333	4.25
T6	0.0	0.90	0.90	0.70	0.833	3.10
T7	1.0	0.40	0.70	0.65	0.583	3.95
T8	1.25	0.55	0.85	0.60	0.666	2.90
T9	1.0	1.25	0.95	1.45	1.216	2.95
T10	1.0	1.25	0.95	1.60	1.266	2.55

Expt. 2 : Control of minor pests.

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam

West Coast : Madakkathara, Vengurle

Maidan tract : Chintamani and Jagdalpur

From the experiment 1, additional observations were also recorded in some of the centres (Bapatla, Chintamani, Jagdalpur and Jhargram) on damage/incidence of certain important minor pests viz. leaf and blossom webber, leaf miner, leaf folder/roller, leaf thrips, inflorescence thrips and leaf weevil.

Bhubaneswar:

Various insect pests encountered throughout the experimental period were shoot tip caterpillar (*Hypatima haligramma*), leaf folder (*Caloptea tiscalea*) and inflorescence thrips (Yellow thrips *Frankliniella schuttzed* and Black thrips *Haplothrips ceylonicus*).

Shoot tip caterpillar:

The data obtained revealed that all the treatments caused significant reduction in pest incidence except unsprayed plot at 30 days of after first spray. The treatment (T1), which received first round spray with monocrotophos, recorded lowest root infestation (2.88%) followed by T5 (4.28%). The incidence of shoot tip caterpillar was found to be non significant after second and third spray.

Leaf folder:

The effect of various insecticide on the incidence of leaf folder indicated that the treatment (T5) which received first round spray with monocrotophos was found significantly superior over other treatments by recording the lowest leaf infestation of 0.93%. Its incidence was not observed after 2nd and 3rd round of spray.

Inflorescence thrips:

Data on the incidence of inflorescence thrips indicated that the population of yellow thrips was non significant among the treatments at 30 days after first and second spray. However the lowest population of yellow thrips (0.18 Nos./inflorescence) was recorded in T5 which received first spray with monocrotophos and second spray with endosulfan. The population of black thrips was non significant at 30 days after second spray but significant at 30 days after third spray. Least population of black thrips (0.58 Nos./inflorescence) was recorded in T8 which received spray of endosulfan (0.05%) at flowering stage followed by neem oil (2%) at fruiting stage (Table 3.9).

Studies on the impact of insecticidal spray schedule in natural enemies (spider, predators such as *Argeope* sp., *Oxytes* sp. And two other unidentified sp.) population revealed that it was non significant at 30 days after 1st, 2nd and 3rd round of spray. Maximum spider population, irrespective of species, was observed in untreated control plots indicating that its population was influenced by the insecticidal spray schedule (Table 3.10).

Table 3.9 : Effect of different insecticidal schedule on insect pest incidence during 1998 at Bhubaneswar.

Treatment	Percent shoot infestation by shoot tip borer*		Percent leaf* infestation by leaf folder at 30 days after 1 st spray	Mean thrips population/inflorescence*			Nut yield (kg/tree)	
	Pre-treatment count	30 days after 1 st spray		YT - 30 days after 1 st spray	30 days after 2 nd spray			BT - 30 days after 3 rd spray
				YT	BT			
T1	10.68 (3.29)	4.76 (2.23)	1.47 (1.26)	0.75 (0.88)	0.41 (0.92)	2.44 (1.70)	1.51 (1.38)	0.97
T2	12.07 (3.54)	5.51 (2.38)	2.08 (1.60)	2.33 (1.64)	0.25 (0.85)	1.46 (1.50)	0.84 (1.12)	1.62
T3	15.80 (3.98)	4.87 (2.27)	2.61 (1.74)	1.79 (1.44)	0.66 (1.06)	2.96 (1.85)	0.84 (1.15)	1.45
T4	12.39 (3.50)	2.88 (1.81)	1.26 (1.31)	1.16 (1.24)	0.25 (0.85)	1.49 (1.41)	1.40 (1.33)	1.90
T5	16.88 (4.04)	4.28 (2.18)	0.93 (1.11)	1.00 (1.19)	0.18 (0.80)	1.46 (1.46)	0.82 (1.13)	1.20
T6	12.08 (3.53)	4.87 (2.27)	1.79 (1.50)	1.29 (1.27)	0.33 (0.81)	1.64 (1.43)	1.63 (1.42)	0.98
T7	13.92 (3.78)	5.50 (2.41)	4.72 (2.27)	1.87 (1.52)	0.58 (1.01)	1.81 (1.32)	0.83 (1.14)	1.60
T8	13.84 (3.77)	6.27 (2.58)	2.83 (1.80)	1.54 (1.37)	0.75 (1.10)	1.84 (1.52)	0.58 (1.03)	2.45
T9	12.91 (3.65)	5.29 (2.39)	3.17 (1.83)	1.41 (1.35)	0.41 (0.92)	3.19 (1.85)	0.84 (1.11)	1.72
T10	15.44 (3.95)	12.46 (3.59)	9.70 (3.15)	3.29 (1.94)	1.70 (2.58)	3.74 (2.05)	2.66 (1.69)	1.85
SE m ±	0.34	0.23	0.24	0.20	0.24	0.18	0.10	
CD 5%	--	0.68	0.68	--	--	--	0.29	

* Means of three replications

Figures in parentheses are $\sqrt{x+0.5}$ transformed means

YT: Yellow thrips *Frankliniella schultzei* Trybom; BT: Black thrips *Haplothrips ceylonicus* Schumtz

Table 3.10 : Effect of different treatments on spider population

Treatments	Mean number of spiders per quadrant (irrespective of species)*		
	30 days after 1 st spray	30 days after 2 nd spray	30 days after 3 rd spray
T1	0.00 (0.70)	1.68 (1.32)	0.52 (0.94)
T2	1.20 (1.31)	2.36 (1.65)	0.87 (1.14)
T3	0.24 (0.84)	3.05 (1.85)	1.12 (1.24)
T4	0.23 (0.79)	1.20 (1.28)	0.48 (0.92)
T5	1.22 (1.23)	1.12 (1.20)	0.24 (0.81)
T6	1.09 (1.26)	1.07 (1.23)	0.35 (0.81)
T7	0.45 (0.91)	2.20 (1.58)	0.92 (1.16)
T8	0.92 (1.09)	2.47 (1.75)	0.67 (1.02)
T9	0.74 (1.02)	1.14 (1.11)	0.50 (0.93)
T10	2.56 (1.71)	3.24 (1.90)	0.24 (0.83)
SEm±	0.21	0.39	0.26

* Means of three replications

Figures in parentheses are $\sqrt{x+0.5}$ transformed means

Chintamani :

The incidence of leaf miner and leaf thrips was least in trees in which second spray was given 30 days after the first spray. Similarly the incidence of inflorescence thrips was least in plants where second spray was given (Table

3.11). Incidence of inflorescence thrips was least in plants where the third spray was given, incidence was least in T 9 (2.25 per panicle) followed by T 8, T 7, T5 and T6 which were all not significantly different treatments to T 9.

Table 3.11 : Incidence of leaf miner, leaf thrips and inflorescence thrips in different treatments at Chintamani.

Treatment	Per cent leaf miner incidence		Per cent leaf and blossom webber incidence			Leaf thrips No./leaf		Inflorescence thrips No./panicle	
	Pre-treatment	30 days after I spray	Pre-treatment	30 days after I spray	30 days after II spray	Pre-treatment	30 days after I spray	30 days after II spray	30 days after III spray
T1	4.67	1.04	0.63	0.30	4.79	3.35	0.87	10.17	13.92
T2	4.53	29.07	0.51	8.60	0.66	3.49	8.80	1.76	13.38
T3	4.31	30.96	0.54	8.62	11.65	3.67	8.77	9.73	2.99
T4	4.88	1.61	0.94	0.33	0.65	3.66	0.87	1.47	13.18
T5	4.77	1.25	0.87	0.33	0.33	3.64	0.91	1.44	2.65
T6	4.22	1.59	0.92	0.32	11.07	3.53	0.94	9.63	2.66
T7	4.07	29.85	0.86	8.06	0.54	3.59	8.76	1.66	2.40
T8	4.15	28.50	0.91	8.58	0.34	3.54	8.90	1.59	2.31
T9	4.17	28.20	0.87	8.64	0.38	3.74	8.78	1.63	2.25
T10	3.85	27.55	0.72	8.62	12.03	3.60	8.82	10.19	14.29
SEm±	0.27	1.26	0.20	0.16	0.43	0.15	0.22	0.33	0.27
CD 5%	NS	4.03	NS	0.51	1.37	NS	0.70	1.05	0.86
CV %	19.60	22.16	20.45	9.70	31.97	12.90	17.01	21.18	12.25

Jhargram :

During the first round of spray the mean incidence of leaf miner was 0.85, 0.90, 0.91 and 0.93 in T1, T4, T5 and T6 respectively as compared to 5.0% in control. After second round treatment the results shows that the mean incidence of leaf miner was very low in T4 and T5. The mean incidence of shoot and blossom webber was 0.58 in T4 and 0.57 in T5 followed by 1.08 in T1 and 1.09 in T6 as compared to 5.6% in

control. During the second treatment, the mean incidence of shoot and blossom webber was 1.39 in T4 and 1.41 in T5 followed by 2.16 in T6. From the above mentioned results it is evident that T4 and T5 gave best results against leaf miner and blossom webber. The nut yield was higher in T4 and in T5 as compared to control. The mean nut yield was 2.850 kg/tree in T4 and 2.800 kg/in T5/tree as compared to 1.020 kg/tree in control.

Table 3.12 : Incidence of minor pests in different treatments at Jhargram.

Treatments	Pre-treatment counts		After first spray		After second spray		Yield (kg/tree)
	Leaf miner	Shoot and blossom webber	Leaf miner	Shoot and blossom webber	Leaf miner	Shoot and blossom webber	
T1	--	--	0.85	1.08	5.25	4.8	2.250
T2	--	--	2.53	2.0	4.86	5.6	2.010
T3	0.1	--	2.72	4.8	9.0	10.3	1.190
T4	--	--	0.90	0.58	1.45	1.39	2.850
T5	--	--	0.91	0.57	1.44	1.41	2.800
T6	--	--	0.93	1.09	4.2	2.18	2.400
T7	--	--	2.92	5.2	5.8	6.53	2.180
T8	--	0.1	3.0	5.29	6.0	7.43	1.90
T9	--	--	3.1	5.33	6.2	7.98	1.950
T10	--	--	5.0	5.61	9.8	14.2	1.020
CD 5%			0.091	0.085	0.09		0.058

Madakkathara:

The incidence of infestation by minor pests like leaf miner, leaf roller, leaf and blossom webber were very low

in T7 followed by T6 (Table 3.13). In the case of thrips, the lowest infestation was in T7 followed by T5.

Table 3.13 : Incidence of minor pests of cashew at Madakkathara

Treatments	Pre-treatment (%)		After 2 nd spray(%)				After 3 rd spray(%)	
	Leaf miner	Leaf roller	Blossom Webber	Thrips	Mean score	Thrips	Mean score	
								Shoot
T1	Skipped the first spray							
T2	4.67	11.68	2.67	2.25	2.45	0.11	2.90	0.35
T3	3.43	14.44	3.29	3.43	4.89	0.30	3.65	0.55
T4	4.00	18.33	5.20	1.86	2.00	0.14	9.15	0.63
T5	3.25	16.56	4.55	2.43	3.67	0.30	4.12	0.37
T6	3.85	14.23	2.00	1.98	2.68	0.25	8.27	0.49
T7	5.20	10.00	1.55	1.44	2.35	0.26	2.12	0.15
T8	6.20	13.77	2.01	3.85	3.33	0.29	5.65	0.47
T9	5.85	13.00	3.44	4.33	6.08	0.6	7.2	0.49
T10	7.33	19.98	6.77	5.20	8.90	0.77	9.75	0.55
CD 5%	4.23	3.97	4.01	2.89	2.14	0.13	2.21	0.63

By skipping the spray of Endosulfan 0.05% in treatment (T7 & T8) the occurrence of natural enemies like ants,

spiders, mirid bugs and chrysopea population did not get affected much (Table 3.14).

Table 3.14 : Occurrence of natural enemies at Madakkathara

Treatment	Pre treatment		After 2 nd spray				After 3 rd spray			
	Ants	Spider	Ants	Spider	Mirid bugs	Chrysopa	Ants	Spider	Mirid bugs	Chrysopa
T1	Skipped first spray									
T2	3.65	0.33	3.77	1.34	1.79	2.13	4.85	1.97	0.33	0.98
T3	1.11	0.40	3.25	1.86	0.88	1.85	2.63	1.32	0.13	1.35
T4	1.44	0.50	0.89	0.97	1.05	3.26	1.55	0.87	0.26	0.65
T5	0.35	0.66	1.45	1.00	0.77	1.77	2.25	0.96	0.43	0.563
T6	0.45	0.35	2.85	1.73	1.62	4.22	1.98	1.22	0.34	0.94
T7	0.55	0.63	3.75	2.45	1.78	3.97	2.88	2.83	0.67	1.27
T8	0.99	0.35	3.20	3.33	1.99	4.00	1.66	2.04	0.93	1.93
T9	2.04	0.47	2.66	1.41	0.89	2.66	2.66	0.97	0.45	0.67
T10	1.00	0.60	2.09	1.33	1.80	2.00	2.00	2.14	0.53	1.22
CD 5%	1.76	0.73	2.73	2.02	1.45	2.12	2.12	1.93	1.09	1.11

Vengurle :

All the insecticidal treatments were statistically significant over control at all the three stages i.e. Pea nut, Pebble nut and Mature nut (Table 3.15). At all the stages, treatment T5 was found most

effective. At pea nut and pebble nut stage T5 was found significantly superior over rest of treatments except T7 and T6 whereas at mature nut stage T5 was found significantly superior over all other treatments.

Table 3.15 : Incidence of inflorescence thrips on cashew at different stages at Vengurle

Treatment	Damage at			Yield (kg/tree)
	Pea nut	Pebble nut	Mature nut	
T1	14.53	22.45	29.98	2.090
T2	14.87	23.55	29.81	2.472q
T3	14.38	21.28	26.34	2.083
T4	14.29	20.60	24.58	1.776
T5	12.32	18.15	21.06	3.202
T6	13.79	19.35	25.00	1.863
T7	13.79	19.86	23.75	3.125
T8	14.67	21.27	25.05	3.848
T9	15.12	21.24	26.44	2.328
T10	27.27	34.27	42.02	1.283
SE m ±	0.50	0.51	0.40	
CD 5%	1.48	1.52	1.19	

Vridhachalam:

The incidence of pink leaf folder *Anigraea albomaculata* Hamp., green leaf folder *Sylepta auraitiacalis* Fisch, nut

borer *Thuylocoptila panerosema* and other minor pest was low in treatment T5 (Table 3.16).

Table 3.16: Incidence of minor pests of cashew in different insecticidal treatments at Vridhachalam.

Treatment	Per cent damage per quadrant						
	Leaf miner	Pink leaf folder	Green leaf folder	Leaf & blossom webber	Nut borer	Mealy bug	Thrips
T1	12.10	12.60	10.20	7.30	7.90	0.50	2.50
T2	19.60	14.28	11.60	8.50	6.50	1.25	1.75
T3	20.50	18.60	14.26	14.21	1.90	0.78	2.35
T4	10.23	9.45	8.77	6.24	5.35	0.49	1.20
T5	3.70	4.25	3.70	4.40	1.25	0.00	0.50
T6	10.35	9.67	10.20	7.30	1.85	0.50	0.75
T7	4.10	5.29	4.30	5.35	1.60	0.45	0.95
T8	21.30	23.05	17.60	18.65	1.75	0.54	1.73
T9	23.24	27.50	19.50	18.23	1.82	1.20	1.39
T10	26.72	29.32	24.85	21.75	8.37	2.15	2.79

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

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%) followed by 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

Jhargram:

The mean incidence of leaf and blossom webber was 2.6 in T5 and 3.2 in T6 followed by 5.2 in T7 (Table 3.17). The results indicated that commercial neem product can be used in lieu of monocrotophos. These treatments were

also applied against inflorescence thrips and the result shows that T5 and T6 were significantly superior than other treatments. The mean incidence of thrips was 1.3 and 1.4 in T5 and T6 respectively. The maximum incidence of this pest was recorded in control.

Table 3.17: Incidence of pests in different cashew cultivars at Jhargram

Treatments	Shoot and blossom webber	Inflorescence Thrips
T1	6.5	5.2
T2	8.9	5.3
T3	9.6	6.3
T4	11.2	6.9
T5	2.6	1.3
T6	3.2	1.4
T7	5.2	4.5
T8	16.8	10.4
CD 5%	0.12	0.09

Expt. 3 : Evaluation of new chemicals for control of TMB and other pests (New trial)

Centres:

East Coast : Bapatla and Bhubaneswar

West Coast : Madakkathara and Vridhachalam

Maidan Tract : Jagdalpur

Treatments :

T 1 : Recommended sprays for the region

T 2 : Chlorpyrifos 0.05%

T 3 : Triazophos 0.1%

T 4 : Ethofenprox 0.015%

T 5 : Profenophos 0.05%

T 6 : Control

Bapatla:

Among the new insecticides tested the percent reduction in major population of Shoot tip Caterpillar - *Hipotima haligramma* Weevils - *Myllocerus* sp. Leaf folder - *Caloptilea tiselea* is more in Profenophos 0.15% treated trees and equally faring along with recommended spray schedule i.e. T1 (Table 3.18). Similarly, the percentage

of nuts damaged by leaf webber - *Lamida moncusalis* was reduced to minimum in trees treated with chlorpyrifos 0.05% along with recommended spray schedule.

In supporting to reduction in pest population, maximum yield per tree (3.750 kg/tree) recorded in trees treated with Profenophos 0.15% and closer to this is trees treated with recommended spray schedule.

Table 3.18 : Effect of new chemicals against the pests of cashew at Bapatla.

Treatments	Pre-treatment population		I Post treatment population		II Post treatment population		III Post treatment population		Yield Kg/ year/tree			
	L.f. %	S.T.C. L.W.	L.f. %	S.T.C. L.W.	L.f. %	S.T.C. L.W.	L.f. %	S.T.C. L.W.				
	December 97	January 98	February 98	April 98	on nuts	on nuts	on nuts	on nuts				
T1- Monocrotophos 0.05% at flowering Carbaryl 0.1% at fruit & nut stage	20.10	2.50	4.50	15.50	8.25	4.05	5.00	5.50	2.50	2.00	8.20	3.50
T2- Chlorpyrifos 0.05%	24.50	2.66	5.50	21.25	9.50	5.80	17.00	7.80	5.00	5.25	8.75	2.74
T3- Triazophos 0.05%	21.50	2.55	7.25	20.25	8.75	6.25	17.00	8.00	6.50	7.55	10.05	2.25
T4- Ethofenprox 0.05%	16.50	2.50	4.50	12.25	6.50	4.20	10.50	5.25	5.50	6.00	9.50	2.10
T5- Profenophos 0.15%	12.50	1.50	2.55	8.80	5.65	1.00	5.25	3.25	2.00	2.75	7.80	3.75
T6- Control	16.50	3.50	3.65	17.80	16.25	3.75	16.35	16.50	7.50	6.75	15.95	1.15

Bhubaneswar:

Shoot tip caterpillar and tea mosquito bug were the two major pests recorded during the experimental period.

Table 3.19 : Effect of insecticides on incidence of shoot tip caterpillar and tea mosquito bug at Bhubaneswar

Treatments	Per cent shoot infestation* by shoot tip caterpillar		Per cent panicle infestation* by tea mosquito bug		Nut yield (kg/tree)
	Pre treatment count	30 days after 1 st spray	30 days after 2 nd spray	30 days after 3 rd spray	
T1	5.53 (2.42)	3.49 (1.80)	4.68 (2.14)	17.05 (4.17)	327
T2	9.46 (3.04)	4.23 (2.12)	5.11 (2.33)	19.20 (4.40)	2.64
T3	7.07 (2.60)	4.85 (2.25)	4.72 (2.23)	18.31 (4.31)	1.57
T4	8.17 (2.80)	4.89 (2.24)	4.42 (2.15)	15.91 (3.97)	3.64
T5	8.25 (2.78)	7.55 (2.67)	5.30 (2.39)	13.53 (13.64)	2.21
T6	8.74 (2.82)	13.12 (3.48)	12.96 (3.64)	27.27 (5.26)	3.62
SEm±	0.41	0.28	0.23	0.31	
CD 5%	--	0.84	0.69	0.93	

* Means of three replications

Figures in parentheses are $\sqrt{x+0.5}$ transformed means

The data revealed that 1st spray of all recommended insecticides proved to be effective in reducing the infestation of shoot tip caterpillar (Table 3.19). T1 which received 1st spray of monocrotophos (0.05%) was significantly superior over control showing least infestation (3.49 %) and at par with T2 (4.23 %) which received 1st spray of chlorpyrifos.

Studies on impact of various insecticides on TMB incidence revealed that all the insecticides were found effective and significantly superior over control at 30 days after 2nd spray. The treatment T5 with ethofenprox showed the lowest panicle infestation (4.42 %)

and was at par with T1 (4.68%), T3 (4.72%) and T2 (5.11%). At 30 days after third spray all the treatments were found significantly superior over control in recording the infestation of TMB. The least per cent panicle infestation (13.53) was recorded in the treatment T5 which received three rounds of spray with profenophos followed by ethofenprox (15.91).

Chintamani:

Observations indicated that all the chemicals tried resulted in effective control of TMB, leaf miner, leaf and blossom webber and leaf thrips and all were at par with each other (Table 3.20).

Table 3.20 : Incidence of Tea mosquito, leaf miner and inflorescence thrips in different treatments.

Treatment	Per cent tea mosquito incidence		Per cent leaf miner incidence		Per cent leaf and blossom webber incidence		Leaf thrips No./leaf	
	Pre-treatment	30 days after I spray	Pre-treatment	30 days after I spray	Pre-treatment	30 days after I spray	Pre-treatment	30 days after I spray
T1	2.17	0.68	4.08	0.84	0.70	0.30	3.27	0.68
T2	2.04	0.70	4.03	0.85	0.73	0.47	2.98	0.73
T3	2.04	0.86	3.87	0.70	0.75	0.86	3.21	0.60
T4	2.18	0.72	4.25	0.93	0.74	0.52	3.19	0.61
T5	2.12	0.61	3.99	0.87	0.92	0.51	3.46	0.84
T6	2.23	25.4	4.43	26.08	0.75	9.27	2.81	8.23
SEm±	0.35	0.59	0.45	0.55	0.20	0.14	0.28	0.28
CD 5%	NS	2.14	NS	2.00	NS	0.51	NS	1.02
CV %	40.44	29.82	26.70	26.49	63.88	17.84	21.81	35.53

Jagdapur:

Among all the treatments T5 i.e. T5 - Profenophos 0.05% at flushing, flowering and fruiting stage gave maximum yield with less incidence of

pests followed by T1 and T3 (Table 3.21). On the basis of nut yield T5 treatment gave 3.03 times more nut yield as compared to untreated control.

Table 3.21: Efficacy of different new chemicals against the pest complex in cashew at Jagdalpur

Treatment	Per cent flower damage by TMB	Per cent leaf damage by TMB	Per cent leaf damage by leaf miner	Per cent leaf damage by cater pillar	Per cent leaf damage by leaf roller	Yield/ tree (Kg)
T1	9.81	8.27	4.37	9.74	9.32	7.42
T2	12.93	10.04	11.17	16.94	11.99	5.04
T3	12.98	9.43	5.53	6.67	11.49	6.12
T4	14.11	8.55	6.57	5.87	17.29	5.37
T5	6.69	6.74	8.63	8.47	6.66	8.00
T6	15.11	10.5	9.85	14.21	7.7	2.64

Madakkathara:

The incidence of TMB and other minor pests was recorded at Madakkathara and the data are presented in Table 3.22 and 3.23. The incidence of other minor pests was

recorded before the treatment as well as thirty days after the treatment. The data however indicate that standard spray is superior over other treatments.

Table 3.22 : Tea mosquito bug (TMB) incidence at Madakkathara

Treatment	Replication 1		Replication 2		Replication 3		Replication 4	
	%	Score	%	Score	%	Score	%	Score
T1	7.64	0.14	9.33	0.05	13.77	0.14	0.00	0.00
T2	10.52	0.13	13.00	0.11	7.90	0.04	4.63	0.01
T3	26.30	0.18	6.11	0.02	11.5	0.10	8.44	0.04
T4	14.20	0.13	14.55	0.20	5.34	0.01	11.33	0.11
T5	13.75	0.09	6.55	0.01	0.00	0.00	7.44	0.02
T6	19.65	0.13	12.88	0.25	9.70	0.20	10.61	0.15

Table 3.23 : Occurrence of minor pests in cashew at Madakkathara

Treatment	Pre-treatment (%)		Post-treatment (%)		
	Leaf miner		Leaf miner		Leaf roller
	Shoot	Leaf	Shoot	Leaf	
T1	--	2.33	--	1.11	0.55
T2	1.32	1.98	0.55	1.65	--
T3	--	1.32	--	0.98	2.65
T4	2.90	1.28	1.32	1.65	--
T5	--	2.67	--	1.45	--
T6	1.39	3.25	--	3.65	--

Vridhachalam:

The results of the experiment on new chemicals for control of TMB as well as other pests of cashew are presented in Table 3.24 and 3.25. However, the

most effective treatment was standard spray i.e. monocrotophos 0.05% at flushing, endosulfan 0.05% at flowering and carbaryl 0.1% at fruiting stage.

Table 3.24 : Incidence of TMB in treatment of different chemicals at Vridhachalam

Treatment	TMB damage score																Yield (kg/tree)
	Pre-treatment count				Shoot				Panicle				Apple and Nut				
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	
T1	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.460
T2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	1.0	1.0	0.0	0.0	1.320
T3	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0	1.250
T4	0.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.200
T5	0.0	1.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.210
T6	1.0	0.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	2.0	1.050

Table 3.25: Effect of new chemicals on minor pests of cashew

Treatments	Per cent damage per quadrant					
	Leaf miner	Pink leaf folder	Green leaf folder	Leaf & blossom webber	Nut borer	Thrips
T1	4.22	4.98	4.50	5.48	1.73	0.83
T2	4.75	5.22	4.45	5.73	2.76	1.26
T3	5.38	6.74	5.27	5.29	2.35	1.10
T4	4.95	5.33	6.39	7.00	3.10	1.15
T5	5.21	6.23	7.28	6.95	3.27	1.32
T6	27.23	26.75	23.72	22.34	9.20	8.55

Project Title: Ent.2 : Control of stem and root borer.

Expt.1 : Prophylactic control trial.

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam

West Coast : Madakkathara, Vengurla

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

Treatments :

Swabbing with Neem oil 5% in 25 trees

T1 Twice + Sevidol 75g

T2 Thrice + Sevidol 75g

T3 Four times + Sevidol 75g

Swabbing with coal tar + Kerosene (1:2) in 25 trees OR mudslurry + carbaryl

T4 Twice + Lindane 0.2%

T5 Thrice + Lindane 0.2%

T6 Four time + Lindane 0.2%

T8 Control

Bapatla:

Among the different prophylactic measures tried, 0-5.6 re-infested trees were recorded in the trees treated with neem oil 5% swabbing and incorporation of sevidol 150gm into soil folowed by neem oil 5% swabbing on trunk alone. Among all the treatments proved neem

oil swabbing at a cost of Rs. 20.40 per trees, where as the best treatment proved costly with a cost of Rs. 28.50 per tree (Table 3.26).

An entomogenous fungus i.e., *Metarhizium anisopliae* was found to be infecting mature grubs of *Plocaederus ferrugineus* in potted seedlings.

Table 3.26 : Prophylactic control trials of CSRB at Bapatla

Treatment	Percentage of freshly infested trees				Cost/tree Rs. Twice a year	
	January 97	February 97	December 97	May- June 98		
T1	Mudslurry swabbing with carbaryl	20.00	23.53	24.00	23.00	20.60
T2	Sevidol 75g to soil + carbaryl swabbing	6.70	20.00	6.70	16.00	25.40
T3	Sevidol 75g to soil + neem oil swabbing	0.00	5.00	5.60	5.00	28.50
T4	Neem oil 5% swabbing on trunk	5.00	5.55	5.00	5.50	20.40
T5	NSK extract swabbing on trunk	6.30	12.50	6.50	10.50	10.50
T6	Phorate application 10G 150 g and BHC 10% dust 500-1000 g per tree followed by nuvacron spray 0.05%	0.00	5.25	3.50	5.00	28.00
T7	Endosulfan application dust 500 g and phorate 150 g followed by Nuvacron spray 0.05%	5.00	5.00	4.50	5.00	26.00
T8	Control	40.00	45.00	40.00	45.00	--

Bhubaneswar:

Before carrying out the treatments, the collar region and exposed roots of the trees were cleaned. Monthly observation was recorded regarding the fresh incidence of stem and root borer after imposition of treatments. Out of various prophylactic measures, the mud slurry + carbaryl along with lindane soil application (T5 & T6) were found to be better than the neem oil swabbing treatments. However four times neem oil swabbing with sevidol application (T3) gave less infestation (2%) as

compared to twice swabbing with mud slurry with lindane (T4) having 4% infestation. Maximum infestation (20%) is observed in untreated control throughout the period of observation.

Jhargram:

The results indicated that T3 i.e. neem oil (5%) swabbing and soil application of Sevidol 8 G (75 gm/tree) gave best protection to the crop from the attack of stem and root borer followed by T2 and T4 (Table 3.27). The infestation of stem and root borer was negligible.

Table 3.27: Influence of prophylactic treatments on incidence of CSRB at Jhargram

Treatments	No. of trees treated	No. of trees having borer eggs before treatment	Percent infestation after treatment	Stages of infestation in infested trees (%)			
				Early stage	Middle stage	Advanced stage	Dead
T1	20	3	10	5	5	--	--
T2	20	3	5	5	--	--	--
T3	20	3	--	--	--	--	--
T4	20	4	5	--	--	--	--
T5	20	3	15	10	15	--	--
T6	20	3	10	5	5	--	--
T7	20	3	15	--	10	5	--

The results of another experiment showed that plants treated with neem oil (5%) and soil application of Sevidol 8 G (75g/tree) gave best protection against CSRB in all treatments i.e. T1, T2 and

T3. Incidence of CSRB was negligible in T5 (Table 3.28). Carbaryl (Mudslurry) + Lindane (0.2%) solution (four times) also showed good results.

Table 3.28: Influence of prophylactic treatments on incidence of CSRB at Jhargram

Treatments	No. of trees treated	No. of trees having borer eggs before treatment	Percent infestation after treatment	Stages of infestation in infested trees (%)			
				Early stage	Middle stage	Advanced stage	Dead
T1	25	2	--	--	--	--	--
T2	25	4	--	--	--	--	--
T3	25	3	--	--	--	--	--
T4	25	3	10	5	5	--	--
T5	25	3	5	5	--	--	--
T6	25	4	--	--	--	--	--
T7	25	4	20	10	10	--	--

Madakkathara:

The prophylactic treatments with neem oil 5% swabbing four times along with Sevidol 4 G, 75g per tree was found to be more effective than the other treatments during the season. Treatment with Carbaryl 0.2% in

mudslurry resulted in lowest fresh incidence (Table 3.29). The CSRB incidence was very severe during March-May period in all the treatments when compared with untreated control.

Table 3.29: Incidence of CSRB under prophylactic treatment trial at Madakkathara

Treat ment	Applic	Cleara	Application			Cleara	Appli	Clear	Appli	Clear		
	ation	nance	Mar.	Apr	May	nance	cation	nance	cation	nance		
	Jan.	Feb.				June	July	Aug	Sept	Oct.	Nov	Dec.
T1	4	2	--	--	1	1	--	--	2	--	1	2
T2	2	3	--	--	--	1	--	--	--	--	--	1
T3	2	1	--	--	--	--	--	--	--	--	--	1
T4	2	2	--	--	1	2	--	--	1	--	2	2
T5	3	3	--	--	1	1	--	--	2	--	1	1
T6	4	3	--	--	--	--	--	--	1	--	1	2
T7	4	4	4	4	4	3	3	4	5	5	5	5

Vridhachalam:

Prophylactic control trials indicated swabbing with neem oil four times along with soil application of sevidol 75 g or swabbing thrice or more with coal tar +

kerosene (1:2) along with application of lindane 0.2% was effective in controlling the CSRB (Table 3.30).

Table 3.30 : Control of cashew stem and root borer under prophylactic trial at Vridhachalam.

Treatment	Trees having eggs after treatment	Trees infested after treatment	Per cent infestation after treatment			
			Early	Middle	Advanced	Dead
Swabbing with Neem oil 5% in 25 trees						
T1 Twice + Sevidol 75g	3	2	2.0	6.0	--	--
T2 Thrice + Sevidol 75g	1	1	2.0	2.0	--	--
T3 Four times + Sevidol 75g	--	--	--	--	--	--
Swabbing with coal tar + Kerosene (1:2) in 25 trees						
T4 Twice + Lindane 0.2%	2	2	6.0	2.0	--	--
T5 Thrice + Lindane 0.2%	--	--	--	--	--	--
T6 Four time + Lindane 0.2%	--	--	--	--	--	--

Expt. 2 : Curative control trial

Centres :

East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast : Madakkathara and Vengurle

Treatments:

T1 : Extraction of grubs

T2 : Swabbing twice with neem oil 5% or

Mudslurry + carbaryl or

Coal tar + kerosene (1:2)

Anyone of the above which is most effective

T3 : T1 + T2 + Lindane soil application 0.2%

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

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

T6 : Control

Design : CRD

Madakkathara:

Sept-Oct. 1998 and is continuing, the

The experiment was started during

data are presented in the Table 3.31.

Table 3.31: Recovery of the CSRB infested trees under curative trial at Madakkathara

Treat ment	No. of trees	Stage of attack						Recovery of the trees					
		Early		Middle		Advanced		Early		Middle		Advanced	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
T1	4	--	--	3	12	1	4	--	--	3	12	--	--
T2	4	2	8	2	8	--	--	2	8	1	4	--	--
T3	Implemented in January 1999. Data not available												

Vridhachalam:

Treatments T3 and T5 were superior than the rest of the treatments.

Treatment T4 was also at par with the Treatment T3 and T5 (Table 3.32).

Table 3.32: Control of stem and root borer under curative trial.

Treatment	No. of trees	Stage of attack			Recovery stage		
		Early	Middle	Advanced	Early	Middle	Advanced
T1 Extraction of grubs	20	5	7	8	4	2	--
T2 Swabbing twice with coal tar and kerosene (1:2)	20	7	7	6	4	--	--
T3-T1+T2 and Lindane soil application	20	8	6	6	7	3	--
T4 - T1&T2+Sevidol soil application	20	8	6	6	6	3	--
T5 - T1 & T2 + <i>Metarrhizium anisopliae</i>	20	7	7	6	6	4	--

Ent.3 : Bioecology of pests of regional importance and survey of pest complex and natural enemies.

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam

West Coast : Madakkathara, Vengurla

Maidan tract : Chintamani and Jagdalpur

Cashew stem and root borer (*Plocaederus* spp.) was observed throughout the year in all the centres, causing moderate to high damage in east and west coast centres, and low to moderate damage in the plains. Tea mosquito bug (*Helopeltis antonii*); Leaf miner (*Acrocercops syngramma*); Apple and nut borer (*Thylocoptila panerosema*, *Nephopteryx* spp.); Leaf and blossom webber (*Lamida monocusalis*); Inflorescence thrips (*Rhynchothrips rapensis*); Leaf thrips (*Rhipiphorothrips cruentatus*); Shoot tip caterpillar (*Hypotima haligramma*); Leaf folder (*Caloptila tiselea*); Leaf weevils (*Myloccerus* spp.); Aphids (*Toxoptera odinae*); Leaf beetle (*Monolepta longitarsus*); Mealy bug (*Ferrisia virgata*); Termites: *Odontotermes* spp., *Microtermes* spp) and Bark eating caterpillar (*Indarbella* sp.) were the other pests of cashew recorded by the different centres.

Apart from these main insect pests, other pest species reported from the centres which included blister beetles, treehopper, spittle bug, nut crinkler, plantbug, stem girdler leaf roller, leaf twisting weevil, slug caterpillar and grasshopper.

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

Natural enemies of cashew pests:

Indigenous natural enemies of several pests were recorded from various centres (Table 3.33). Seven natural enemies were recorded on leaf and blossom webber (*Lamida monocusalis*), *Apanteles* sp. was mainly recorded during Jan-Feb in low and moderate numbers, in east coast and plains. *Elasmus johnstonii* and *Bracon brevis* Cornis were the other parasitoids recorded in moderate numbers in east coast and plains during Oct-May in

different centres. Tachinid parasite, spiders and larval and pupal parasitoids were recorded parasitising and preying on the larvae in various centres during different months.

The tea mosquito bug had a natural enemy complex comprising of reduviid bugs, spiders and preying mantids which prevailed during the cropping season in low numbers in the plains.

Coccinellid beetles, syrphids, preying mantids, *Chrysoperla* were recorded at Vengurla and Vridhachalam

during most part of the year, while at Chintamani centre, the coccinellid population was observed during Dec to May.

Trees above 35 years age have suffered during cyclone and recovered in West Godavari district. Pruning of lower branches and application of neem oil 5% to base of trunk prevented trees from borer infestation.

During the flowering season of 1997-98, the plantations of Srikakulam

district were visited and the infestation of TMB was recorded. In Vajrapu Kotturu Mandal attack was up to 75% and 50-90% loss in yield was assessed in the gardens of Akkupalli, Gunipalle, Goduru, Bottupuram and Vajrapu Kotturu areas.

Potentiality of parasites on *Lamida monocusalis* was recorded ranging from 11.53 to 49.25%. Infestation by mealy bug, *Ferrisia virgata* was recorded up to 5-10% in young plantations.

Table 3.33 : Occurrence of different pests of cashew and their natural enemies at Bapatla

Location	Month	Pest recorded		Per cent infestation	Intensity of attack
		Common Name	Scientific name		
Guntur Dist.	April 97	Stem & root borer	<i>Plocaederus ferrugineus</i> L.	1-3%	Low
		Leaf folders	<i>Caloptilea tiselea</i>	1-5%	Low
		Hairy caterpillar	<i>Euproctis scintillans</i>	Sparse	Negligible
		Fruit webber	<i>Lamida monocusalis</i>		
West Godavari Dist.	September 97	Shoot tip caterpillar	<i>Hipotima haligramma</i>	1-2%	Low
		Leaf miner	<i>Acrocercops syngamma</i>	2-5%	Medium
		Defoliators	<i>Thallosodes quadraria</i>	--	Negligible
		Stem & root borer	<i>Plocaederus ferrugineus</i> L.	3-5%	Medium
Guntur Dist.	October 97	Leaf folders	<i>Caloptilea tiselea</i>	--	Low
		Stem & root borer	<i>Plocaederus</i> sp.	5-7%	Medium
Prakasam Dist.	December 97	Stem & root borer	<i>Plocaederus</i> sp.	9-10%	High
Srikakulam Dist	April 97	Stem & root borer	<i>Plocaederus</i> sp.	2-5%	Medium
		Apple & nut borer	<i>Nephoteryx</i> sp.	1-5%	Low
		Tea Mosquito	<i>Helopeltin antonii</i>	70-75%	Severe
		Fruit Webber	<i>Lamida monocusalis</i>	5-6%	Medium
		Shoot tip caterpillar	<i>Hipotima haligramma</i>	20-25%	Medium
Krishna Dist.	October 97	Shoot tip caterpillar	<i>Hipotima haligramma</i>	1-5%	Medium
		Leaf miner	<i>Acrocercops syngamma</i>	1-2%	Low

Bhubaneswar:

The extent of insect pests infestation and their seasonal incidence at Bhubaneswar was recorded from twelve selected cashew trees under unsprayed conditions from January 98 to December 98 (Table 3.34 and 3.35).

Shoot tip caterpillar was active in the field throughout the year except June and February. The peak incidence of the pest (a maximum of 11.48% shoot infestation) was recorded during first fortnight of August.

The incidence of leaf feeding chrysonolid beetle was noticed during June and July just after the onset of the south-west monsoon on new flushes. The peak period of incidence was maximum of 10.45% laterals with 4.72% leaf infestation was recorded during 2nd fortnight of June.

The leaf miner infestation was noticed during August to October. The peak period of its activity (a maximum of 12.6% laterals with 5.43% leaf

infestation) was recorded during the second fortnight of August.

Apple and nut borer infestation was observed during March - May. Maximum incidence (4.72% apple and nut infestation) was recorded during second fortnight of April.

Yellow thrips was observed from January to first fortnight of March with maximum of 4.72% incidence in the second fortnight of January whereas Black thrips was observed from second fortnight of January to first fortnight of April. Maximum incidence (5.82%) of Black thrips was observed during second fortnight of February. Besides these, the other minor pests like leaf folder, brown aphid (*Toxoptera orlinae* Vd.G.), mealy bug (*Ferrisia virjata*, Gundhi bug (*Leptocoriza acuta* Thumb), hairy caterpillar, bark borer (*Indarbela tratraonis* and termites (*Odontotermis* sp.) was also observed. But their extent of damage was negligible.

Table 3.34 : Screening of MLT- 92 entries for their resistance/tolerance to shoot tip caterpillar during 1998 at Bhubaneswar.

Cashew varieties	Percent shoots damaged by shoot tip caterpillar*
	Range
M 44/3	5.26 - 11.84
M 15/4	5.06 - 13.92
BPP 30/1	13.51 - 24.32
H 367	2.50 - 15.00
H 303	7.31 - 14.63
H 255	1.28 - 7.69
BPP 3/28	1.36 - 6.84
H 320	20.00 - 30.76
H 68	6.00 - 14.28
BPP 3/33	16.21 - 21.62
BPP 10/19	8.97 - 17.85
NRCC-2	10.52 - 19.73
NRCC-1	33.33 - 60.00

Table 3.35 : Screening of MLT - 86 entries for their resistance/ tolerance to shoot tip caterpillar at Bhubaneswar

Cashew Varieties	Per cent shoots damaged by shoot tip caterpillar* (Range)
T 129	1.63 - 10.16
H 1608	1.40 - 3.03
V 4	3.70 - 13.79
H 2/16	1.72 - 20.00
M 26/2	1.78 - 15.50
V 3	6.25 - 20.31
H 1610	1.53 - 5.88
V 2	3.50 - 25.00
BPT 40	1.88 - 25.00
M 1600	3.50 - 13.84
VTH 44/3	8.69 - 31.8
VTH 30/4	7.14 - 21.53
M 44/3	6.15 - 21.21
H 2/15	0.00 - 22.22
H 1598	3.38 - 25.42
VTH 39/2	8.33 - 20.16

* Observation taken during September-November.

Natural enemies:

Study on field parasitization of major insect pests on cashew indicated that on an average shoot tip borer, leaf and blossom webber were parasitized to an extent of 12% and 10% respectively. Maximum parasitization (22%) of leaf and blossom webber by *Bracon brevicornis* was noticed during May. Peak parasitization (12%) of shoot tip borer by *Elasmus* sp. Was observed during October. The other predators present in cashew ecosystem were spiders (*Argeopi* sp., *Oxyopes* sp.), lady bird beetle (*Verania cincta* Gorn., *Menochilus sexmaculata* F.), Black ant (*Camponotus* sp.), mirid bug

(unidentified). The population of spiders, lady bird beetle and ants were noticed and recorded.

Chintamani:

The incidence of tea mosquito bug started in II fortnight of September and reached maximum in I fortnight of February (51.21%) and thereafter sudden reduction in population was noticed. It was found feeding on guava from July to September and on neem from August to November. However, the incidence of tea mosquito on guava was least (6.36%) but that in neem was high (61.32%) in November (Table 3.36).

The incidence leaf miner was first

noticed in II fortnight of August and it reached maximum (29.08%) during II fortnight of December and thereafter gradual reduction was noticed and the pest was absent from first fortnight of April.

The incidence of leaf and blossom webber was generally low during the year. The incidence started during I fortnight of September and reached maximum during II fortnight of February (12.11%). The pest was absent from May first fortnight.

The incidence of leaf thrips was first noticed in June II fortnight and reached maximum during during II fortnight of December (11.11 No./leaf) and thereafter there was gradual reduction of the population. The pest remained absent from I fortnight of April. During the off season the pest survived on younger plants.

Maximum incidence of inflorescence thrips was noticed during I fortnight of March (17.11 No./panicle) and thereafter gradual reduction of the pest was noticed. The pest remained absent from I fortnight of June.

The incidence of fruit and nut borer was first noticed during I fortnight of

March and reached maximum (11.26%) during II fortnight of May and thereafter sudden reduction was noticed. The incidence of the pest was severe in off-season bearing plants. Totally 31 insect species feeding and breeding on different parts of the plant have been recorded on cashew. Months of occurrence and intensity were also recorded.

Jagdalpur:

The insect attack was found in the order of stem and root borer > termite > tea mosquito bug > leaf minor > leaf folder > leaf and blossom webber, apple and nut borer and aphid. The predators and parasite present in cashew ecosystem were the Spiders, Preyingmentid Reduvid bug, Black ant, Wasp, leady bird beetle and Apantales.

Jhargram:

Maximum damage by CSRB was recorded in West Midnapore and in coastal region. Old and neglected plantations were severely damaged by this pest. Incidence of TMB was noticed in different parts of the State. It caused low to moderate damage during flushing and flowering stages (Table 3.37).

Table 3.36 : Seasonal occurrence of major pests of the region at Chintamani

Months	Quarter	Per cent Tea mosquito incidence	Per cent Leaf miner incidence	Per cent leaf & blossom webber	Leaf thrips No./leaf	Infloresc ence thrips No./inflo rescence	Per cent fruit and nut borer
January	I	43.48	26.02	11.06	8.37	6.32	--
	II	48.26	21.11	12.11	9.68	12.06	--
February	I	51.21	19.02	7.08	5.81	14.12	--
	II	42.36	17.11	4.24	2.63	16.68	--
March	I	30.63	8.26	2.02	1.01	17.11	0.81
	II	12.14	0.36	1.13	0.36	13.96	1.26
April	I	6.08	--	0.82	--	12.11	3.08
	II	1.11	--	0.11	--	6.38	4.19
May	I	0.12	--	--	--	2.12	7.06
	II	--	--	--	--	0.21	11.26
June	I	--	--	--	--	--	6.11
	II	--	--	--	0.18	--	0.18
July	I	--	--	--	1.86	--	--
	II	--	--	--	2.61	--	--
August	I	--	--	--	1.98	--	--
	II	--	0.18	--	2/93	--	--
September	I	--	2.62	0.41	4.16	--	--
	II	0.42	3.11	1.62	6.08	--	--
October	I	0.66	7.08	2.32	3.48	--	--
	II	1.81	10.11	3.81	6.14	--	--
November	I	2.02	18.48	4.63	7.83	--	--
	II	12.18	21.63	7.81	6.92	--	--
December	I	14.86	24.16	8.68	10.08	0.38	--
	II	21.08	19.08	9.82	11.11	3.68	--

Leaf and blossom webber incidence was noticed during the month of July and upto March. Maximum damage was recorded during the month of September which decreased gradually. Most of the plantations were damaged by shoot thrip caterpillar during the month of September and October.

The hairy caterpillar damage was severe in some plantations of Midnapore. Population of leaf miner was noticed during the month of September coinciding with flushing and the pest remained active up to December. Maximum population was recorded (12.9%) during the first week of

November. From January to April, thrips were active and the damage was maximum in the third week of February (11.2%). Termite damage to the crop was found in red and lateritic zone of West

Bengal (West Midnapore, Bankura and Purulia). Incidence of apple and nut borer was recorded from February to April. Maximum damage was noticed during the month of March (2.67%).

Table 3.37 : Incidence of different pests of cahew in comparison with weather parameters at Jhargram.

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days	Percentage of damage					
	Maximum	Minimum	AM	PM			TMB	Leaf and blossom webber	Leaf miner	Inflorance Thrips	Apple and Nut borer	Shoot tip cater pillar
January	22	13	94	53	68.4	10	9.4	3.8	--	2.8	--	--
February	27	17	90	51	13.4	6	6.9	1.0	--	11.2	1.0	--
March	31	20	95	61	158.6	7	4.3	0.6	--	8.2	2.2	--
April	36	24	94	77	29.7	5	1.2	--	--	2.6	2.6	--
May	37	27	93	80	74.9	10	--	--	--	--	0.8	--
June	38	29	88	74	120.9	12	--	--	--	--	--	--
July	34	28	91	72	182.8	18	--	0.4	--	--	--	--
August	33	27	95	79	172.4	12	--	4.5	--	--	--	2.2
September	32	27	96	73	173.2	12	--	10.9	2.8	--	--	10.4
October	33	26	96	77	120.4	13	0.6	17.3	6.6	--	--	8.6
November	28.6	21	95	62	28.6	3	3.0	11.8	12.9	--	--	--
December	26	14	97	45	--	--	4.2	6.3	4.3	--	--	--

Survey of pest complex and their natural enemies :

The incidence of shoot tip caterpillar was much higher than the previous year. The percentage of infestation was 18.5% in Midnapore (West) and 12.6% at Midnapore (East). The incidence of hairy caterpillar *Estigmene lactinea* was maximum in Midnapore. In the western part of Bankura and Purulia, incidence of CRSB was very low but the population of shoot and blossom webber was 11.8 and 12.0 per cent during the first week of October. Termite, thrips,

leaf miner and shoot tip caterpillar were also recorded.

During survey spiders, coccineilled beetles and braconid parasite were recorded in different plantations. It may be mentioned that about 4.9 to 10.2% larvae of leaf shoot and blossom webber and 3.8 to 8.5% larvae of leaf miner were parasitized by the braconid parasite. In some areas leaf and blossom webber were parasitized by *Apentales* sp. (2.8 to 5.6%).

Madakkathara:

Tea mosquito infestation was recorded throughout the year except in June and July (Table 3.38). The incidence on shoots was very high during December - April period ranging from 1.24 to 11.55 whereas on panicle and nut it ranged from 6.35 to 53.65%. The minor pests recorded were leaf miner

(Aug.-Dec) ranging from 3.00 - 8.96%, blossom webber from (Dec.-Mar.) ranged from 4.56-6.04% and inflorescence thrips (Jan.-Apr.) (Table 3.39). The natural enemies and other agents noticed in the unsprayed area were ants, spiders, mirid bugs, chrysopa, honey bees, flies and wasps (Table 3.40).

Table 3.38: Comparison of weather data with the occurrence of TMB during 1998 at Madakkathara.

Month	Temp.(°C)		RH%		Rain fall (mm)	Rainy Days	Shoots		Panicle		Nuts	
	Max.	Min.	AM	PM			%	MS	%	MS	%	MS
Jan.	33.1	22.8	78	49	0	--	--	--	--	--	36.22	0.7
Feb.	34.4	23.6	77	51	0	--	--	--	--	--	--	--
Mar.	36.2	23.6	86	47	11	1	--	--	--	--	--	--
April	36.5	25.6	86	50	61.4	4	--	--	--	--	--	--
May	34.1	25.2	90	63	203	9	--	--	--	--	--	--
June	30.2	23.3	94	79	809.3	24	--	--	--	--	--	--
July	29.2	23.6	96	80	752.9	28	--	--	--	--	--	--
Aug.	29.8	23.9	95	77	433.6	18	1.24	0.07	--	--	--	--
Sept.	30.2	23.3	96	78	571.3	24	11.55	0.62	--	--	--	--
Oct.	32.2	23.6	88	65	194.7	12	--	--	6.35	0.25	42.6	0.44
Nov.	31.5	23.1	92	64	109.4	9	--	--	53.65	0.75	11.35	0.33
Dec.	30.1	22.9	79	58	33	4	--	--	--	--	14.60	0.32

Table 3.39 : Comparison of weather data with the occurrence of minor pests during 1998 at Madakkathara.

Month	Temp.(°C)		RH%		Rain fall (mm)	Rainy Days	Leaf miner		LR %	BW %	Thrips		AP&NB
	Max	Min.	AM	PM			ST%	LS%			Nts %	MS	
Jan.	33.1	22.8	78	49	0	--	--	--	--	1.43	6.75	0.22	1.30
Feb.	34.4	23.6	77	51	0	--	--	--	--	--	--	--	0.87
Mar.	36.2	23.6	86	47	11	1	--	--	--	--	--	--	--
April	36.5	25.6	86	50	61.4	4	--	--	--	--	--	--	--
May	34.1	25.2	90	63	203	9	--	5.79	--	--	--	--	--
June	30.2	23.3	94	79	809.3	24	--	8.23	0.95	--	--	--	--
July	29.2	23.6	96	80	752.9	28	--	3.44	2.63	--	--	--	--
Aug.	29.8	23.9	95	77	433.6	18	1.24	3.00	--	--	--	--	--
Sept.	30.2	23.3	96	78	571.3	24	11.55	--	3.22	--	--	--	--
Oct.	32.2	23.6	88	65	194.7	12	--	8.96	--	4.56	2.05	0.02	--
Nov.	31.5	23.1	92	64	109.4	9	--	--	--	5.24	4.63	0.11	--
Dec.	30.1	22.9	79	58	33	4	--	--	--	6.04	8.97	0.22	1.34

ST = Shoot; LS = Leaves; LR = Leaf roller; BW = Blossom webber; MS = Mean score; AP&NB = Apple and nut borer and Nts = Nuts.

Table 3.40 : Comparison of weather data with the occurrence of natural enemies and other insects during 1998 at Madakkathara.

Month	Temp.(°C)		RH%		Rain fall (mm)	Rainy Days	Ants	Spider	Mirid Bugs	Chrysope	H.Bees and others
	Max	Min	AM	PM							
Jan.	33.1	22.8	78	49	0	--	0.24	0.48	--	--	0.67
Feb.	34.4	23.6	77	51	0	--	0.36	0.67	--	--	0.44
Mar.	36.2	23.6	86	47	11	1	0.11	0.44	--	--	--
April	36.5	25.6	86	50	61.4	4	0.05	--	--	--	--
May	34.1	25.2	90	63	203	9	0.43	0.23	--	--	--
June	30.2	23.3	94	79	809.3	24	0.39	0.18	--	--	--
July	29.2	23.6	96	80	752.9	28	0.96	1.44	--	--	0.22
Aug.	29.8	23.9	95	77	433.6	18	1.44	0.32	0.44	--	0.44
Sept.	30.2	23.3	96	78	571.3	24	1.27	2.11	0.67	--	0.80
Oct.	32.2	23.6	88	65	194.7	12	2.6	2.00	0.75	--	1.35
Nov.	31.5	23.1	92	64	109.4	9	3.4	1.77	0.21	--	1.86
Dec.	30.1	22.9	79	58	33	4	3.44	2.33	--	--	1.00

Vengurle:

During the year 11 pests and five common insects were surveyed at Sindhudurg district of Maharashtra. Tea mosquito bug (*Helopeltis antonii*) was found to occur throughout the year and was severely damaging during the season November - December. Flower thrips were also common and the population was very high during Jan - March. CSRB and leaf miners were found throughout the year and the attack was low. Aphids, mealy bugs, apple and nut borer, lady bird beetles parasiting on aphids, preying mantids, chrysope and hymenopteran parasites on apple and nut borer were prevalent during Jan - April and all were found infesting in low intensity. Besides these pests, spiders and other minor insects were also found throughout the year and their population was low.

Vridhachalam:

At Vridhachalam, stem and root borer, leaf weevil, preying mantids and

spiders were found throughout the year. CSRB was found very high during May - July with a population intensity of 5%. Other major insects present were leaf miners during Oct - Jan, leaf folders during Nov - Feb. Hairy caterpillar were very high during March (18.5%). Besides these pests, apple and nut borers, termites, mealy bugs, aphids and leaf thrips were found in cashew plantations in low intensity. High population of parasitoids was found during Dec - March. In March, their population was 45%.

Pathogenic fungi

The fungus, *Metarrhizium anisopliae* was found to pathogenise the grubs of CSRB in cashew and their population was also very high during Jan - Feb. Another pathogenic fungus *Beauveria bassiana* was found to cause disease in stem and root borer grubs which was very high in November (11.5%).

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

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam

West Coast : Madakkathara, Vengurle

Maidan tract : Chintamani

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

Bapatla:

The germplasm entries were screened against their tolerance/susceptibility of the pests on

cashew such as leaf and blossom webber, leaf miner, shoot tip inflorescence caterpillar, apple and nut borer and leaf folders (Table 3.41).

Table 3.41: Details of germplasm subjected to screening at Bapatla.

Germplasm		Age	Date of Planting
No. of entries	No. of trees available	Years	
17	41	8-9	1988
12	16	6-7	1991
13	39	4-5	1992

During the year under experimentation, among the germplasm entries of 8/9 years age group, T.241 (5.4%), H 7/3 (7.85%), GG 4/4 (8.80) were found to be tolerant to infestation of leaf folder while T.No.275 (18.18%) exhibited maximum susceptibility. The incidence of leaf webber on foliage, GG 4/4 recorded least i.e. 1.0 population of leaf webber along with T.241 (1.0) while H

316 (4.00%) was found to be least susceptibility to leaf webber damage on nuts (Table 3.42). Among the entries in 5 years age group, 30/1 recorded minimum percent of leaf folder (2.50%), leaf miner (1.50%) as well as leaf webber on nuts (1.50%) where as entries from Tamil Nadu State were found to be maximum susceptibility to leaf folder and leaf webber incidence (Table 3.43).

Table 3.42: Pest incidence during flowering season at 8 years of age at Bapatla.

Variety	Leaf damage %		Population mean of LW.	Nuts damaged %
	Leaf folder	Leaf webber		
AP 6	9.25	6.10	12.0	15.0
KO 1/5	14.50	3.00	7.0	12.10
Hy 7/3	7.85	8.30	5.0	13.50
H 12/6	13.69	7.00	2.0	15.60
T 210	9.60	5.00	9.0	14.00
T 282	12.80	5.60	16.0	16.50
H 316	10.35	4.64	2.0	4.00
H 413	10.50	10.50	2.5	10.30
H 314	10.00	8.00	2.0	8.50
GG 4/4	8.80	2.50	2.0	15.30
GG 3/10	12.16	10.35	--	18.00
AP 19	9.33	11.30	5.5	14.00
GG 3/7	12.15	12.00	1.5	25.50
T 71	15.90	4.00	5.6	9.00
T 241	5.40	10.50	1.0	8.50
T 275	18.18	6.40	--	9.00
T 129	20.70	7.50	5.5	10.50

Table 3.43 : Pest incidence during flowering season at 5½ years of age at Bapatla.

Variety	Leaf damage %	
	Leaf miner	Leaf webber
3/28	6.00	5.00
3/33	3.50	3.50
10/19	3.00	4.50
30/1	1.50	1.50
Hy 68	2.05	5.25
Hy 267	6.50	6.50
HY 303	8.20	5.50
Hy 255	8.00	6.00
Hy 320	3.50	5.00
M 44/3	6.60	6.75
M 15/4	6.50	6.50
107/3	1.00	7.50
40/1	5.80	7.25

Bhubaneswar:

Thirteen MLT entries and sixteen MLT entries were screened for resistance against shoot tip borer under field condition during 1998. The result indicated that none of the cashew types were free from the attack of shoot tip borer during its peak activity. BPP 3/33 in MLT 2 and H 1608 in MLT showed lowest damage i.e. 6.84 % and 3.03% respectively. Whereas the cashew type NRCC 1 in MLT 2 and VTH 44/3 in MLT 1 were highly susceptible to the pest attack.

Fifty numbers of germplasms were evaluated for resistance against shoot tip borer under field condition. None of the accession were free from the attack of shoot tip borer during its peak activity. The accession OC 27 showed lowest damage (5.00% shoot infestation) followed by the accession OC 49 (5.33%), OC 29 (6.37%). The accession OC 41 (31.7% shoot infestation) was most susceptible followed by OC 2 (28.28%) and OC 38 (25%).

Survey of cashew pests and its natural enemies :

Survey of insect pests of cashew and its natural enemies were carried out on various plantations in Nayagarh, Dhenkanal, Ganjam, Koraput and Jajpur districts during 1998. The important insect pests, natural enemies and pollinators in each district have been recorded. The salient observations were :

1. Plantation in high altitude areas of Nayagarh district are more susceptible to tea mosquito bug.
2. The infestation of stem and root borer in high altitudes areas of Koraput district and Nayagarh

district is low as compared to other areas.

3. The inflorescence thrips are a major pest during flowering stage of the crop in almost all the cashew plantations.

Chintamani:

Accession/varieties of multi-location trial were screened for tea mosquito. The results revealed that all the accessions/varieties were affected by tea mosquito at panicle stage. However the least mean damage score was recorded in TN-40 (0.34), H 1610 (0.42), M 44/3 (VRI) (0.61) and Vengurle-3 (0.61) (Table 3.44). In germplasm ME 4/4 (0.46) AND 1/64 (0.43) recorded least damage score. Field confinement test at flushing stage revealed that even though the damage was there, the damage score was 0.90 and 1.05 respectively.

Jhargram:

Ten germplasm types were screened against shoot tip caterpillar and inflorescence thrips, none of the screened germplasm were found to be resistant. The mean incidence of shoot tip caterpillar and thrips were recorded from 4.5% to 10.3%.

Madakkathara:

The accessions considered to be tolerant/less susceptible at Madakkathara after natural infestation for the last four years are Madakkathara-1, H-3-17, 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, T No. 856 (Table 3.45). The grafts of these varieties and other released varieties from Madakkathara as well as Goa 11/6 were subjected to cage multiplication studies during 1998-99 period and reaction to feeding was noted in 0-4 scale range.

Table 3.44 : Tea mosquito damage score in different accessions on panicle Chintamani.

Accessions	TMB Damage
Vengurle-1	2.33
Vengurle-2	1.60
Vengurle-3	0.61
Vengurle-4	1.01
Vengurle-5	1.32
Bapatla-1	1.02
Bapatla-3	3.11
Bapatla-4	3.52
Bapatla-5	0.72
Bapatla-6	2.33
H 1610	0.42
H 1600	3.23
H 1608	0.72
H 1598	0.62
TN 129	3.52
TN 40	0.34
H 2/15	2.06
H 2/16	3.32
Ullal-1	0.72
M 44/3	0.61
Ullal-2	0.82
Vengurle-3	1.01
Vengurle-4	2.36
Vengurle-2	1.32
M 44/3	1.62
H 24	0.72
VTH 12	1.18
VTH 30	1.74
VTH 59	3.23
ME 4/4	0.46
1/64	0.62

Table 3.45 : Tea mosquito bug infestation on shoot and panicles in field confinement studies at Madakkathara.

Varieties	Infestation score
MAD - 1	1-2
A - 26 - 2	1-2
H - 8 - 7	1-2
H - 8 - 8	0-1
H - 5 - 1	0.40
H - 1600	2-3
H - 718	1-2
K - 10 - 1	2-3
H - 3 - 17	0-1
PU - 8	3-4
H - 8 - 15	3-4
A - 6 - 1	2-3
T 856	1-2
MAD 2	1-2
K - 22 - 1	1-2
H - 1598	0-1
H - 1608	2-3
H - 1591	1-2
K - 10 - 2	0-1
Goa 11/6	1-2

Vengurle:

At Vengurle, none of the variety/type were found resistant/tolerant to tea mosquito (Table 3.46).

However, the incidence was found to be the least in V1.

Table 3.46 : Incidence of TMB in different germplasm accessions at Vengurle

Variety	Range of score	Per cent incidence
V-1	0.43 - 0.60	10.71 - 15.00
V-2	0.50 - 0.61	12.50 - 15.20
V-3	0.65 - 0.77	16.15 - 19.27
V-4	0.93 - 1.05	23.21 - 26.23
V-5	0.72 - 0.82	17.98 - 20.56
V-6	0.75 - 0.88	18.75 - 22.06
V-7	0.73 - 0.84	18.33 - 21.11
H - 303	0.96	23.97
H - 320	0.83	20.63
H - 367	0.94	23.46

Vridhachalam:

The lowest TMB incidence was observed in M 26/2 x M 75/3 with mean score of 2.60 and highest damage in M 10/4 x M 26/1 with mean score of 3.20 (Table 3.47). The MLT entries showed a

range of 1.25-2.75 mean score of damage (Table 3.48). The field confinement test on the promising cashew types are in progress.

Table 3.47: Screening of F1 hybrids for major pests of cashew at Vridhachalam.

Crosses	TMB Score	Shoot & blossom webber (%)	Thrips (%)	Damage of shoots per quadrunt	
				Leaf folder	Mealy bug
M 10/4 x M 26/1	3.20	21.75	12.50	20.40	--
M 10/4 x M 45/4	2.55	22.50	12.25	35.20	10.50
M 10/4 x M 75/3	2.90	17.50	6.50	45.00	2.25
M 44/3 x M 26/1	2.85	17.50	18.60	30.00	--
M 26/1 x M 26/1	2.40	20.50	13.40	25.00	7.25
M 26/2 x M 75/3	2.60	19.70	19.50	50.50	--
M 44/3 x M 75/3	3.10	15.50	12.20	50.20	--
M 44/3 x M 45/4	3.00	21.25	9.75	--	--

Table 3.48 : Screening of MLT 86 entries against major pests of cashew at Vridhachalam.

Varieties	TMB Score	Mean per cent of damage of shoot			Mean per cent of damage of leaves	
		Shoot & blossom webber	Leaf folder	Hairy caterpillar	Mealy bug	Thrips
H 1598	2.50	20.0	35.50	--	--	2.0
H 1600	2.00	15.00	20.25	--	--	--
H 1608	1.75	17.50	40.20	25.50	--	--
H 1610	1.75	10.25	15.75	--	7.50	7.00
H 129	2.25	25.00	25.75	--	--	9.25
H 40	2.50	17.50	20.50	--	--	--
H 2/15	2.25	20.50	30.20	50.20	5.0	--
H 2/16	2.50	15.25	22.75	30.25	--	--
M 33/3	2.70	10.50	15.50	--	--	5.50
M 44/3	2.50	25.50	27.00	--	5.00	12.75
M 26/2	1.50	20.40	30.50	--	--	--
VTH 30/4	2.00	15.90	23.50	--	--	12.50
VTH 59/2	1.25	20.75	29.50	15.75	--	--
V 2	2.25	20.25	27.50	--	--	15.00
V 3	2.00	15.00	25.20	--	--	--
V 4	2.75	20.00	30.75	25.80	10.25	--
V 5	2.75	10.75	15.75	--	--	--

(a) HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices and Cashewnut Improvement Project (AICS & CIP) 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 (Tamilnadu), Anakkayam (Kerala) (later shifted to Madakkathara), Vengurle (Maharashtra) and CPCRI, Regional Station, Vittal (Karnataka).

During the fifth plan period, one centre at Bhubaneswar (Orissa) and in sixth Plan period two centres one at Jhargram (West Bengal) and another at Chintamani (Karnataka) were added. During VIII Plan period one centre at Jagdalpur (Madhya Pradesh) and a sub centre at Pilicode (Kerala) were started.

The headquarters of the project was located at Central Plantation Crops Research Institute, Kasaragod. During the Seventh Plan period, the Project was bifurcated into:

1. All India Coordinated Cashew Improvement Project. The headquarters of the independent cashew project was shifted to National Research Centre for Cashew, Puttur in 1986.
2. All India Coordinated Spices Improvement Project.

Presently, there are eight coordinating centres and one sub-centre, four in the east coast viz.

Bapatla, Bhubaneswar, Jhargram, Vridhachalam, three in the west coast viz. Madakkathara, Vengurle, Pilicode and one in the Maidan Parts of Karnataka- Chintamani and one in the Central India at Jagdalpur.

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

1. Evolving high yielding varieties with export grade kernels, tolerant/resistant to pests and diseases.
2. Standardising 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 and research programmes modified / added as per the need in the Workshops held in Trivandrum, Kerala (1972); Coimbatore, Tamilnadu (1975); Panjim, Goa (1978); Trichur, Kerala (1981); Calicut, Kerala (1983); Trivandrum, Kerala (1985); Bhubaneswar, Orissa (1987); Coimbatore, Tamilnadu (1989); National Group discussion in lieu of X Biennial

Workshop at Kasaragod, Kerala (1991); Bangalore, Karnataka (1993), Kasaragod, Kerala (1995) and Dapoli, Maharashtra (1997). Two group

discussions were also held one in horticulture at CPCRI, Regional Station, Vittal (1986) and other in entomology at Trichur (1988).

Group Meeting held at Cashew Research Station (KAU) Madakkathara on 27th April 1998.

In pursuance of the decisions taken in the XIII Biennial Workshop of All India Coordinated Research Project on Cashew held at KKV, Dapoli during 4-6 November 1997, a Group Meeting was held at Cashew Research Station, Madakkathara to develop the soil test based fertilizer recommendations in cashew. The meeting was chaired by Dr. EVV Bhaskara Rao, Project Coordinator & Director, National Research Centre for Cashew, Puttur.

The other members present in this Group Meeting were Dr. M. Abdul Salam, Assoc. Professor & Head, CRS, Madakkathara; Dr. N. Saifuddin, Assoc. Professor (Soil Science), Radio Tracer Laboratory, KAU, Vellanikkara; Mr. CR Shiva Prasad, Senior Scientist, Regional Centre, NBSS&LUP, Hebbal, Bangalore; Dr. M. Lakshminarayana Reddy,

Horticulturist, CRS, Bapatla; Dr. V. Lakshmanan, Jr. Horticulturist, RRS, Vridhachalam; Dr. HB Lingaiah, Horticulturist, ARS, Chintamani; Dr. K.C. Mohapatra, Jr. Horticulturist, CRS, Bhubaneswar and Mr. N. Yadukumar, Senior Scientist (Agronomy), NRCC Puttur.

During the meeting, decisions were taken on developing work plan for attempting the refinement of present fertilizer recommendations based on soil test values. For this, a detailed guideline for soil analysis and generation of data on soil fertility were outlined. The procedure for collecting soil and leave sample for studying soil test based fertilizer recommendation to cashew in every cashew growing districts was circulated to different Coordinating Centres.

The significant achievements of the project are summarised below :

1. During the year 45 germplasm accessions were added to the existing 1018. The Centre wise germplasm holdings are - Bapatla - 127; Bhubaneswar - 89; Jhargram - 118; Vridhachalam - 261; Madakkathara - 127; Pilicode - 64; Vengurle - 161; Chintamani - 106

and Jagdalpur - 10. This brings the collection of germplasm at various Centres of AICRP on Cashew to 1063. Among the germplasm accessions, M 44/3 at Bapatla, H 2/16 at Bhubaneswar, NRCC-1 at Chintamani and JGM 74/6 at Jagdalpur were found promising.

Among the germplasm accessions at Bhubaneswar OC-22 with an average yield of 3.8 kg performed better. 2/6 ARSC at Chintamani performed well with a yield of 10.25 kg per tree. JGM 17/1 has yielded a highest of 12.57 kg/tree during the year at Jhargram. Brazil 248 with 6.1 kg at Madakkathara, 126/17/2 with an yield of 11.40 kg/tree and M 15/4 with an yield of 1.2 kg/tree at Vridhachalam were the highest yielders in each centre.

2. At Chintamani, the variety Vengurla - 5 that yielded 3.78 kg per tree that was highest under comparative yield trial. In Multi-location trial 86 (MLT 86) at Bhubaneswar and Jhargram H 2/16 from Bapatla yielded the highest of 17.10 kg/tree and 7.28 kg/tree respectively. Per tree yield was highest in M 44/3 with 4.60 kg at Jhargram, M 26/2 with a yield of 12.88 kg at Madakkathara and 7.10 kg for Vengurla-5 at Vengurle were the better performing varieties. In MLT 92, H 320 yielded better with 12.00 kg/tree at Bapatla. At Bhubaneswar, 30/1 yielded maximum (8.00 kg/tree). At Chintamani VTH 107/3 yielded 5.5kg/tree which was highest in the centre. M 15/4 at Madakkathara yielded highest and M 44/3 yielded a maximum (2.4 kg/tree) at Vridhachalam.

3. Hybridisation was carried out in different stations by using high yielding local genotypes and other varieties. At Bapatla, 149 F1

seedlings were produced during the year. Bhubaneswar could achieve up to 14.4% success in crossing in BBSR-1 x VTH 711/4. At Chintamani, 26 different F1 hybrid trees got established. At Madakkathara yield of BLA-139/1 X P-3/2 was maximum (450 g) in first harvest. At Vengurle 170 nuts were obtained from different crosses. At Vridhachalam, M 44/3 x M 45/4 yielded highest of 3.5 kg/tree during the year. The grafts of F1 hybrids were being produced at various centres for the vegetative propagation of hybrid planting material.

4. Doses of nitrogen upto 500g increased yield by increased number of flowering laterals sq. m⁻¹ and number of nuts per panicle. 1000g N : 250g P : 250g K was found to be a good fertilizer recommendation at Chintamani and Bhubaneswar. Cowpea inter-crop was found enterprising as mixed crop in cashew plantations at Bhubaneswar and Jhargram and groundnut was found profitable at Vridhachalam.

5. The preliminary results on the density of planting per unit area at Jhargram, maximum yield per block was obtained in 6 x 6 x 6 m triangular planting whereas 5 m x 5 m was found to be yielding highest at Vengurle. However, these results may have to be continued further to obtain appreciable results. Cowpea inter-crop was found enterprising as mixed crop in cashew plantations at Bhubaneswar and Jhargram while

groundnut was found profitable at Vridhachalam. Bitter gourd was found to be highest yielding inter crop at Vengurle.

6. Six dwarf types at Bapatla, one semi dwarf at Bhubaneswar, 10 less vigorous and five vigorous types at Madakkathara and 15 types at Vengurle were under evaluation during the current year.
7. The recommended spraying of monocrotophos 0.05%, endosulfan 0.05% and carbaryl 0.1% at flushing, flowering and fruiting stages respectively reduced percentage of insect infestation at all the Centres. Soil application of Sevidol 8 G 75g per tree and swabbing the trunk at

one meter height and exposed roots with neem oil 5% was found to be good prophylactic measure for the control of attack by cashew stem and root borer (CSRB) for a period of 120 days. At Vridhachalam, treatment with coal tar and kerosene 1:2 was found to be an effective method for control of CSRB. M 25/2 x M 75/3 showed low tea mosquito bug (TMB) damage in the centre.

8. In general, in most of the Centres the yield in early and mid bearing varieties was normal whereas, it was affected in late bearing ones due to climatic influence this year.

(b) TRANSFER OF TECHNOLOGY EFFORTS

Bapatla

More 16000 cashew grafts were produced and supplied to cashew farmers and Govt. Agencies.

Bhubaneswar

During the year three training programmes on pest control were organised in three villages by the Bhubaneswar Centre and 105 farmers participated in this training programme. The Scientists of this Centre have also participated in 6 training programmes related cashew crop management in different districts of Orissa.

35,000 cashew grafts were produced during the year of which 17,000 grafts were supplied to Orissa State Cashewnut Development Corporation Ltd., and to

other State Govt. Agencies.

Shri R.N. Mohapatra, Jr. Entomologist delivered a radio talk on "KAJU FASALARA ROGA POKA NIYANTRANA" on AIR, Cuttack.

Chintamani

During the year the Centre has conducted two training programmes in which sixty farmers were benefited. A total of 40,000 cashew grafts were produced and distributed during the year. 29 demonstration plots are being maintained by the Centre since 1994-95 .

The Scientists of the Centre gave two Radio-talks through AIR Bangalore.

Jhargram

During the year four training programmes on production technology of

cashew were organised for the benefit of farmers. One training programme on Vegetative Propagation of Cashew was organised for personnel deputed by Cashew Development Corporation, Midnapore.

Madakkathara

A training unit of 30-audience capacity has been set up with modern Audio-visual facilities. A total of eight (8) training programmes have been conducted of which four were on cashew apple processing for the benefit of rural women in which eighteen women participated. In another set of four training programmes sponsored by the Directorate of Cocoa and Cashewnut Development, 80 people from the state agricultural department were participated.

32 demonstration plots of one acre size each were laid out in the last four years and maintained in Thrissur, Ernakulam and Palakkad Districts. 18,961 cashew grafts were produced and distributed to the farmers.

The scientists of the Centre gave seven Radio/Television programmes during the year on cashew cultivation and pest management practices.

A cashew apple processing unit was established for the production of non fermented products from cashew apple. The unit is capable of processing half tone of cashew apple per day. An FPO licence was also obtained for the production and sale of cashew apple juice.

During the year, Dr. M. Abdul Salam was a Major Advisor/Member of Advisory Committee for one M.Sc. (Ag) Student and five Ph.D. Students of the College of Horticulture, KAU who are working on various aspects of cashew.

Pilicode

A total of four training programmes were conducted during the year, which was attended by 225 farmers. The scientists of the Centre participated in a seminar conducted by the State Department of Agriculture and took a class on scientific cultivation practices on cashew. The scientists also have participated in exhibitions held at Kannur and Trikarippur.

A talk on Management of Pest of Cashew was given by Dr. Jayaprakash Nayak in AIR, Kannur.

A total of 3300 cashew grafts were produced, out of which 3200 were distributed to farmers and Govt. agencies.

Vridhachalam

Fifteen training programmes were conducted during the year for the benefit of farmers and Govt. officials engaged in cashew farming. Twelve TV programmes and two AIR programmes were attended by the Scientists of the Centre.

A total of 1,20,000 cashew grafts were produced and 93,000 grafts were distributed to farmers and other Govt. Agencies.

(c) STAFF POSITION

HEADQUARTERS:

Project Coordinator	:	Dr. E.V.V. Bhaskara Rao
Technical Information Officer	:	Shri. H. Muralikrishna (from 01.9.1998)
Stenographer	:	Shri O.G. Varghese

PROJECT CENTRES:

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

Horticulturist	:	Dr. M.Lakshmi Narayana Reddy
Asst.Entomologist	:	Vacant
Astt. Agronomist	:	Vacant
Senior Tecnical Assistant	:	Mr. B.Krishnamurthy
Jr.Technical Assistant	:	Mr. K. Ranga Rao
Grafter	:	Mr. V.Kantha Rao

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

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

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

Horticulturist	:	Vacant
Jr.Entomologist	:	Mr. G.T. Thirumalaraj
Jr.Horticulturist	:	Mr. Vishnuvardhan
Sr.Technical Assistant	:	Mr. Shivappa
Sr.Technical Assistant	:	Mr. N.Janakiraman
Grafter	:	Vacant

Zonal Agricultural Research Station, (IGAU), Jagdalpur 494 005, Madhya Pradesh.

Jr.Entomologist	:	Dr. Sanjay Sharma
Jr. Horticulturist	:	Vacant
Sr. Technical Assistant	:	Mr. S. Das (from 4.2.99)
Grafter	:	Mr. Jagdev

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

Horticulturist	:	Dr. A.Bandyopadhyay
Jr.Horticulturist	:	Dr. S.B. Chattopadhyaya
Jr.Entomologist	:	Dr. B.Bandyopadhyay
Sr.Technical Assistant	:	Mr. S.Sarkar
Jr.Technical Assistant	:	Mrs. K.Bose
Grafter	:	Mr. Jagannath Shaw

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

Horticulturist	:	Dr. M. Abdul Salam (Assoc. Prof. Agronomy)
Jr.Entomologist	:	Dr. (Mrs.) Susanamma Kurien (Asst. Prof. Nematology)
Sr.Technical Assistant	:	Mrs. B.Suma
Jr.Technical Assistant	:	Mr. V.O. Joy (from 4.6.98)
Grafter	:	Mr.S.Sasi

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

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

Horticulturist	:	Dr. B.B. Sapkal
Jr.Entomologist	:	Mr. A.Y. Munj
Jr.Breeder	:	Mr. S.B. Deshpande
Sr.Technical Assistant	:	Mr. P.G. Dhuri
Jr.Technical Assisnat	:	Mr. R.L. Mayekar

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

Horticulturist	:	Dr. R. Sankaranarayanan (from 1.5.98)
Jr.Horticulturist	:	Mr. V. Lakshmanan
Jr.Entomologist	:	Mr. V. Ambethgar
Sr.Technical Assistant	:	Mr. S. Manickam
Jr.Technical Assistant	:	Mr. T. Chinnadurai
Grafter	:	Mr. P. Gopalakrishnan

**(d) BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING
1998-99**

ALLOCATION

(Rs. in Lakhs)

Centre	Pay & Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	6.67	0.20	1.20	--	8.07	6.05
Bhubaneswar	6.35	0.20	1.20	--	7.75	5.81
Chintamani	5.50	0.20	1.20	--	6.90	5.18
Jagdapur	1.40	0.15	0.80	--	2.42	1.82
Jhargram	4.33	0.20	1.20	--	5.73	4.29
Madakkathara	5.45	0.20	0.95	--	6.60	4.95
Pilicode	1.57	0.15	0.40	--	2.12	1.59
Vengurle	5.41	0.20	1.20	--	6.81	5.11
Vridhachalam	5.53	0.20	1.20	--	6.93	5.20
TOTAL	42.28	1.70	9.35	--	53.33	40.00

ACTUAL EXPENDITURE

(Amount in Rupees)

Centre	Pay & Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	4,86,480	10,455	1,18,303	--	6,15,238	4,61,428
Bhubaneswar	6,34,017	20,000	1,20,000	--	7,74,017	5,80,513
Chintamani	6,13,471	6,629	1,19,025	--	7,39,125	5,54,344
Jagdapur	2,19,428	13,214	79,293	--	3,11,935	2,33,951
Jhargram	5,20,451	7,400	82,452	--	6,10,303	4,57,727
Madakkathara	5,24,429	19,548	52,503	--	5,96,483	4,47,362
Pilicode	1,33,800	14,000	30,900	--	1,78,700	1,34,025
Vengurle	4,86,847	13,485	1,06,119	--	6,06,451	4,54,838
Vridhachalam	7,01,082	19,744	1,20,000	--	8,40,826	6,30,620
TOTAL	43,20,005	1,24,475	8,28,595	--	52,73,078	39,54,808

(e) MONITORING OF PROJECT BY COORDINATOR

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

27.4.98	:	Madakkathara
22.7.98	:	Pilicode
01.2.99	:	Bapatla
02.2.99	:	Vridhachalam
23.2.99	:	Jagdalpur
25.2.99	:	Bhubaneswar

27.2.99	:	Jhargram
01.3.99	:	Chintamani
17.3.99	:	Vengurle

During the visit to these centres, the technical programmes allotted to each of the centres and the progress made so far was reviewed along with inspection of the field experiments. University authorities were met to apprise the progress of work in the centres.

(f) FUNCTIONING OF EACH CENTRE

Bapatla

The centre was allotted experiments in the disciplines of Crop Improvement, Crop Management and Crop Protection. Attempts should be made to lay out new trials in a systematic way in the new high density planting block. In the Gene Bank six more accessions were added during the year. Lack of training and pruning has retarded the canopy development in all the plants. A suggestion has been given to re-survey the area from where the Guntur dwarf accession were collected.

Bhubaneswar

The Centre has implemented all the programmes allotted during the previous workshop. In varietal evaluation trial Hybrid 2/16 was found to be the best. In multi location trial, 30/1 from Bapatla was found to give 8 kg per plant in the third harvest and well suited under Bhubaneswar conditions. The Hybrid 1608 in MLT 86 was found to yield 13.5

kg per tree and was found promising. In NPK trial, highest yield of 7.10kg was recorded with 1000g N and 250g each of P₂O₅ and K₂O per plant/year. In entomology trials, Mud slurry + Carbaryl along with Lindane as soil application was found to be good for control of Steam and Root Borer at the Centre.

Chintamani

In multi location trial Hybrid 320 was found to be promising. Eight years of yield data is available at the centre for MLT 86 and the same is recommended for statistical analysis of pooled data which may be presented in the agenda papers for the workshop. It was suggested to plant the available graft produced in the Rootstock

Scion interaction studies at 5 m x 5m spacing to achieve closer planting in the available plot. Gubbi 3/108 x Vetore-56 has a very high fruit set. In comparative yield trial with Vengurla

and Bapatla accessions, it was suggested to compare the yield obtained at Chintamani with the yield obtained the respective centres along with the nut size and shelling percentage.

Jagdalpur

In bioecology of the pest of importance in Jagdalpur region, stem and root borer was found to be the major problem in the area with TMB, termite, leaf miner, leaf folder and leaf blossom webber in the order of importance of pests of cashew. In spite of lack of management practices in the forest plantations of Rajnagar, some trees could yield as high as 15-20 kgs/tree. It is worthwhile to collect good mother trees/germplasm accessions from the plantations for further multiplication and testing of varieties suitable for Bastar area.

Jhargram

During the review, a large number of gaps were found in the Multi location trial which was planted during the last year and it was suggested to replant the plot once again. Data on flowering and yield was collected during the current year. In trail on pest of regional importance, it was found that shoot tip caterpillar, shoot and blossom webber and hairy caterpillar are the major menace for cashew growing in this area.

Madakkathara

A Group Meeting for streamlining the soil testing procedures and standardization of fertilizer application

was held at Cashew Research Station (KAU) Madakkathara on 27th April 1998. The research activities going on at the centre were also reviewed during the visit.

Pilicode

During the review at Pilicode Centre, the available data on the varietal evaluation indicated that the performance of Madakkathara-1 is much superior under Pilicode conditions. Despite the recommendations given to the farmers on fertilizer application, it was a general tendency to ignore the recommendations and thus the yield of cashew is very low in farmers plots.

Vengurle

The centre has prepared descriptors of cashew as per the IPGRI proforma for 80 clonal accessions which are now due for publication. Six years date is available at the Centre on the performance of hybrids and it was recommended to multiply these hybrids for further evaluation. In the screening of germplasm, H 303, H 320 and H 37 were found to be promising along with all the released varieties of cashew by the centre.

In the varietal evaluation trial, M 44/3 was found to have minimum canopy spread with dwarf stature. In the spacing trial 5 m x 5 m gave an yield three time more than regular planting. In on-farm trial, it was observed a linear relationship to nitrogen upto 1500g in V-4 grafts of cashew. It was suggested to immediately stop cutting of scion sticks

from NPK experiment plot where the yield was affected due to removal of scion sticks.

Vridhachalam

In the root stock scion interaction studies, M 44/3, M 26/2 and local rootstocks were used and M 44/3 was used as an inter-stock with M 26/2 and M 44/3 as scion varieties. Only the grafts prepared with M 44/3 as inter stock showed lesser success. Grafts of Goa 16/11 collected from NRCC

established well in the field. In screening of the germplasm M 15/4; H 2/15; H 16 and H 59/2 were found resistant to infestation by TMB and it was suggested to carry out caging experiments both on flushes and inflorescence of these varieties.

The centre has collected and multiplied antagonistic fungus *Metarhizium anisopliae* against the CSRB which is of importance in biological control of the pest.

(g) PROBLEMS IN FUNCTIONING OF THE CENTRE

At Bapatla the posts of Asstt. Entomologist and Asstt. Agronomist are vacant and it affected the normal carrying out of the technical programmes allotted to the Centre. At Chintamani centre, the post of Horticulturist has become vacant due to the promotion of the person who held the post. The post of

Grafter is also vacant in the centre. At Jagdalpur, the post of Jr. Horticulturist is still vacant. The concerned Agricultural Universities were apprised about the filling up of these posts for the smooth functioning of the AICRP on Cashew at these Centres.

(h) METEOROLOGICAL DATA OF CENTRES 1998***Bapatla***

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	29.7	19.3	91.0	71.0	3.0	--
February	31.0	21.7	85.0	68.0	--	--
March	32.2	20.8	77.0	68.0	0.8	--
April	33.3	25.2	72.0	71.0	24.1	1
May	38.0	27.4	65.0	64.0	27.6	1
June	38.4	28.3	62.0	56.0	54.6	3
July	34.0	26.0	75.0	66.0	136.7	8
August	33.0	25.6	83.0	76.0	149.7	8
September	32.4	25.4	85.0	77.0	348.2	12
October	30.5	24.2	87.0	82.0	432.7	16
November	30.0	22.3	89.0	81.0	73.3	6
December	28.5	17.2	86.0	64.0	--	--

Bhubaneswar

Month	Temperature (°C)		Mean RH (%)	Total rain (mm)	No. of rainy days
	Maximum	Minimum			
January	28.8	16.5	71	22.4	2
February	31.0	19.0	73	20.9	5
March	33.5	22.1	74	67.3	8
April	36.2	24.4	73	77.8	5
May	38.8	27.1	68	40.5	5
June	36.8	27.2	76	164.4	12
July	32.9	25.5	85	341.5	20
August	32.6	25.9	87	163.5	17
September	32.2	25.3	87	239.1	22
October	31.6	24.2	86	306.6	15
November	30.6	20.7	76	93.5	6
December	28.6	13.3	66	0.0	--

Chintamani

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	28.7	14.3	14.1	12.2	0	0
February	31.3	NR	14.4	15.4	0	0
March	34.1	NR	64.6	33.8	7.0	1
April	35.9	NR	67.2	38.9	19.6	1
May	34.3	NR	70.0	39.8	74.4	5
June	32.5	NR	69.3	46.8	36.0	2
July	29.5	NR	77.9	56.8	92.6	9
August	28.4	NR	81.2	65.9	194.2	9
September	28.4	NR	77.6	74.0	224.4	7
October	27.6	NR	79.0	64.0	199.5	10
November	26.1	NR	75.3	57.6	57.4	3
December	26.2	NR	74.8	69.4	49.2	4

Jagdalpur

Month	Temperature (°C)		RH (%)		Evaporati on(mm)	Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM			
January	27.8	13.6	95	35	3.1	-	-
February	28.2	12.4	91	32	5.6	47.4	3
March	34.0	18.8	75	23	9.5	2.3	1
April	36.9	23.2	69	23	7.2	36.9	4
May	38.6	25.5	61	24	8.0	38.9	3
June	34.0	25.4	71	49	6.4	203.3	8
July	28.7	23.3	91	74	2.7	384.4	17
August	28.9	23.1	92	72	3.0	178.0	14
September	29.6	23.2	93	69	3.1	211.8	12
October	29.1	21.3	94	65	2.7	115.6	7
November	27.4	17.3	96	55	2.5	8.9	5
December	26.2	6.7	96	69.4	2.0	49.2	4

Jhargram

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	22	13	94	53	68.4	10
February	27	17	90	51	13.4	6
March	31	20	95	61	158.6	7
April	36	24	94	77	29.7	5
May	37	27	93	80	74.9	10
June	38	29	88	74	120.9	12
July	34	28	91	72	182.8	18
August	33	27	95	79	172.4	12
September	32	27	96	73	173.2	12
October	33	26	96	77	120.4	13
November	28.6	21	95	62	28.6	3
December	26	14	97	45	--	--

Madakkathara

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	33.1	22.8	78	49	0	--
February	34.4	23.6	77	51	0	--
March	36.2	23.6	86	47	11	1
April	36.5	25.6	86	50	61.4	4
May	34.1	25.2	90	63	203	9
June	30.2	23.3	94	79	809.3	24
July	29.2	23.6	96	80	752.9	28
August	29.8	23.9	95	77	433.6	18
September	30.2	23.3	96	78	571.3	24
October	32.2	23.6	88	65	194.7	12
November	31.5	23.1	92	64	109.4	9
December	30.1	22.9	79	58	33	4

Pilicode

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	32.5	21.3	90.9	61.7	0	0
February	32.6	21.6	89.2	57.3	2.8	1
March	32.9	23.5	84.6	61.8	1.4	1
April	34.7	26.5	81.5	61.8	12.2	2
May	34.4	26.2	83.0	63.0	84.8	8
June	30.3	23.7	95.0	82.0	1108.5	27
July	29.0	23.3	96.4	87.2	944.6	27
August	29.2	23.4	97.2	87.9	611.0	23
September	29.1	23.0	97.5	82.4	589.6	23
October	29.5	22.8	95.0	79.0	389.0	17
November	31.1	22.3	93.0	71.0	60.9	7
December	31.2	21.1	95.0	59.0	60.6	2

Vengurle

Month	Temperature (°C)		Mean RH (%)	Total rain (mm)	No. of rainy days
	Maximum	Minimum			
January	31.9	18.4	82.2	--	--
February	31.8	17.5	74.1	--	--
March	31.0	19.8	80.7	--	--
April	33.1	23.7	74.8	--	--
May	33.9	26.7	74.9	52.0	2
June	31.5	25.7	83.2	1014.2	23
July	29.9	25.2	88.3	908.0	31
August	30.1	24.9	90.6	499.8	30
September	29.8	24.4	91.9	312.0	25
October	30.7	23.7	88.1	304.0	17
November	31.9	20.4	81.9	60.4	7
December	32.7	16.7	77.2	--	--

Vridhachalam

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	30.7	22.4	89.5	73.0	--	--
February	32.7	23.8	89.0	64.0	--	--
March	37.2	25.4	91.0	60.5	--	--
April	40.4	28.4	91.5	75.0	--	--
May	42.4	29.6	86.5	51.0	66.5	3
June	40.9	28.5	81.0	65.0	18.4	2
July	38.3	26.5	82.0	62.5	84.4	5
August	36.9	20.2	89.0	63.0	147.0	5
September	37.6	22.3	86.4	63.0	72.6	10
October	35.7	21.3	90.2	74.4	123.4	15
November	33.2	20.0	70.8	65.0	567.4	12
December	29.8	18.4	87.3	87.0	316.0	10

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