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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 on going project (AICS & CIP) was bifurcated in to 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 (BSKVV the then 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 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 2000-2001 was Rs. 101.18 lakhs (Rs. 75.88 lakhs ICAR Share) and the

expenditure was Rs. 83.60 lakhs (Rs. 62.70 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 agro-techniques 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 36 accessions were collected by the coordinating centres of which 22 were field planted bringing the total collection to 1128. Among the germplasm accessions evaluated at Bhubaneswar, the maximum yield was recorded in OC - 65 planted in 1993 with a yield of 3.60 Kg tree⁻¹. At Chintamani, the highest yield (16.10 Kg tree⁻¹) was reported for 44/5 ARSC (V-5) planted in 1995. At Jagdalpur, highest yield was recorded for NRC-138 (380g tree⁻¹) planted in 1996. Highest yield for JGM 74/6 planted in 1983 (14.79 Kg tree⁻¹) was reported at Jhargram. Among the new



germplasm, M 89/2 has given the highest yield of 2.8 Kg tree⁻¹ six years after planting at Vridhachalam. Among the released varieties evaluated, the data indicated that V-5 showed highest number of bisexual flowers under Bapatla conditions. Among the 24 released varieties tested, maximum yield was observed for BPP-5 planted in 1990 at Madakkathara.

Under the varietal evaluation, three experiments are under progress at various centres of AICRP. The nut yield was highest in Vengurla-3 (11.08 Kg tree⁻¹) at Chintamani under comparative yield trial planted in 1986. The Multi location trial (MLT) 86 was started during 1986 at Chintamani and Vengurle and during 1987 at Bhubaneswar, Jhargram, Madakkathara and Vridhachalam. However, due to cyclone in 1999 the trial was completely damaged at Bhubaneswar and was discontinued. During the year under MLT 86 the yield was significantly high in M 44/3 (5.93 Kg tree⁻¹) at Chintamani. Highest nut yield per tree was recorded for H 2/16 (8.80 kg tree⁻¹) at Jhargram. Highest yield was reported for V-5 (12.56 Kg tree⁻¹) from Madakkathara. Among the varieties tested under MLT - 92, highest yield was obtained for variety 30/1 (2.80 Kg tree⁻¹) planted at Bapatla during 1993. Maximum yield was obtained for H 367 (5.64 Kg tree⁻¹) planted in 1992 at Bhubaneswar. At Chintamani, maximum plant height (4.98 m) and maximum yield (5.52 Kg tree⁻¹) were recorded for Hy 302 planted in 1992. Maximum plant height (2.90 m) and yield (1.59 Kg tree⁻¹)

were observed in H 303 planted in 1997 at Jagdalpur. At Madakkathara, the highest yield was obtained from M 15/4 (21.90 Kg tree⁻¹) planted in 1993. Highest plant girth and highest yield (6.976 Kg tree⁻¹) was obtained in M 15/4 planted in 1994 at Vridhachalam. A total of 112 hybrid nuts were obtained from the crossing programme carried out at Bapatla. A maximum yield of 10.2 Kg tree⁻¹ was obtained for hybrid 4/1. At Bhubaneswar, eight different cross combinations were made and 149 hybrid nuts were obtained. Highest yield was obtained for Bhubaneswar C-1 x VTH 711/4 (0.750 Kg tree⁻¹) five years after planting. During the year 22 different crosses were made and 74 hybrid nuts were obtained at Chintamani. Among the 56 hybrids planted in 1993 highest yield was obtained from V-5 x H 1591 (2.9 Kg tree⁻¹) at Madakkathara and nine hybrids were field planted in 2000 for further evaluation. During the year 14 different cross combinations were undertaken and 1051 hybrid seeds were obtained at Vengurle. H 641 planted in 1991 performed better than other hybrids in terms of yield (5.99 Kg tree⁻¹). At Vridhachalam, the combination M 10/4 x M 26/1 thirteen years after planting produced the highest yield of 4.8 Kg tree⁻¹.

CROP MANAGEMENT

Highest yield under NPK trial was obtained for 1000g N, 125g P, 125g K (3.50 Kg tree⁻¹) at Bapatla in BPP-5. At Jhargram, the combination 1000g N, 250g P, 250g K resulted in maximum yield (5.47 Kg tree⁻¹)



in the variety Jhargram-1. At Madakkathara, the application of 500g N, 125g K resulted in maximum yield (10.21 Kg tree⁻¹) in BLA 39/4 nine years after planting in interaction trial. At Vengurle, the 1000g N, 250g P, 250g K interaction trial with variety V-1 ten years after planting (4.25 Kg tree⁻¹) was significantly superior over other treatments in NPK interaction. Fertilizer application in high-density cashew plantations was initiated in all the centres.

Under spacing trial laid in the year 1982, maximum yield per hectare (752.11Kg ha⁻¹) was noted in 6x6x6 m triangular system of planting at Jhargram Centre. Among the trees planted in 1990, the yield in treatment of 5x5m square (1573 Kg ha⁻¹), 5x5m square with thinning (1672.00 Kg ha⁻¹) and 5x5m square with 75% thinning (1721.20 Kg ha⁻¹) were on par with each other and were significantly superior over the rest of treatments at Vengurle.

Intercropping trial indicated that during kharif season cluster bean was found to be most economical and during Rabi black gram was found to be remunerative at Bapatla. At Bhubaneswar, cashew intercropped with turmeric fetched highest returns. Growing of tuber crops in cashew plantations was not found to be economical during the year under Madakkathara conditions. At Vridhachalam, it was found that the groundnut is highly profitable as an intercrop in cashew plantation.

Planting of grafts of Chintamani-1 at

Chintamani and Vengurle-7 at Vengurle were done during the year for carrying out drip irrigation trial.

CROP PROTECTION

At Chintamani, least incidence of TMB was recorded in trees received spray at flushing, flowering and fruiting stages. The population of natural enemies was highest in untreated control (T-10) during all the stages. However, in experiment initiated during 1995-96 on BLA 139-1 the yield was highest for trees sprayed with monocrotophos at flushing, endosulfan at flowering and carbaryl at fruiting (T-5, 6.59 Kg tree⁻¹). At Jagdalpur also, the maximum yield was recorded for the trees treated with treatment T-5 (6.0 Kg tree⁻¹). The treatment T-5 was found to be more effective than the other treatments after third spray, but however, the results were not significant at Vengurle. Standard spray (T5) was found to be most effective treatment at Vridhachalam.

In the experiment on alternative chemicals, the standard spray was the most effective treatment compared to other treatments at Bhubaneswar. At Chintamani, highest yield of 6.25 Kg tree⁻¹ was recorded in treatment with profenophos. At Jagdalpur ethofenprox 0.015% was found to be better than all other treatments. Spraying monocrotophos at flushing (T1) was the most effective control for pests of cashew at Jhargram. Highest yield was reported from Madakkathara in treatment T5 (8.80 Kg tree⁻¹). At Vengurle, spraying with



chlorpyrifos (0.05%) was found to be effective in controlling TMB. Standard spray (T1) was found to be most effective at *Vridhachalam*.

For control of cashew stem and root borer (CSRB) at Bhubaneswar, the treatment *mud slurry + carbaryl swabbing* along with lindane soil application was found to be better. Swabbing of neem oil and soil application of Sevidol 8G 75g tree⁻¹ was most effective prophylactic control tried in Jhargram. Neem oil 5% swabbing along with lindane 0.2% and Mud slurry + Carbaryl 0.2% at four intervals were found to be more effective in Madakkathara. At Vengurle, swabbing with neem oil 5% along with Sevidol 4G soil application was found to be promising. Swabbing coal tar thrice with the application of Lindane 0.2% was most effective treatment at *Vridhachalam*.

Under curative trial, the treatment *mud slurry + carbaryl swabbing* with Sevidol application (T2) was found better recovery percentage than other treatments at Bhubaneswar. The percentage of recovery was higher in T2 even in middle stages of CSRB attack and also higher in comparison

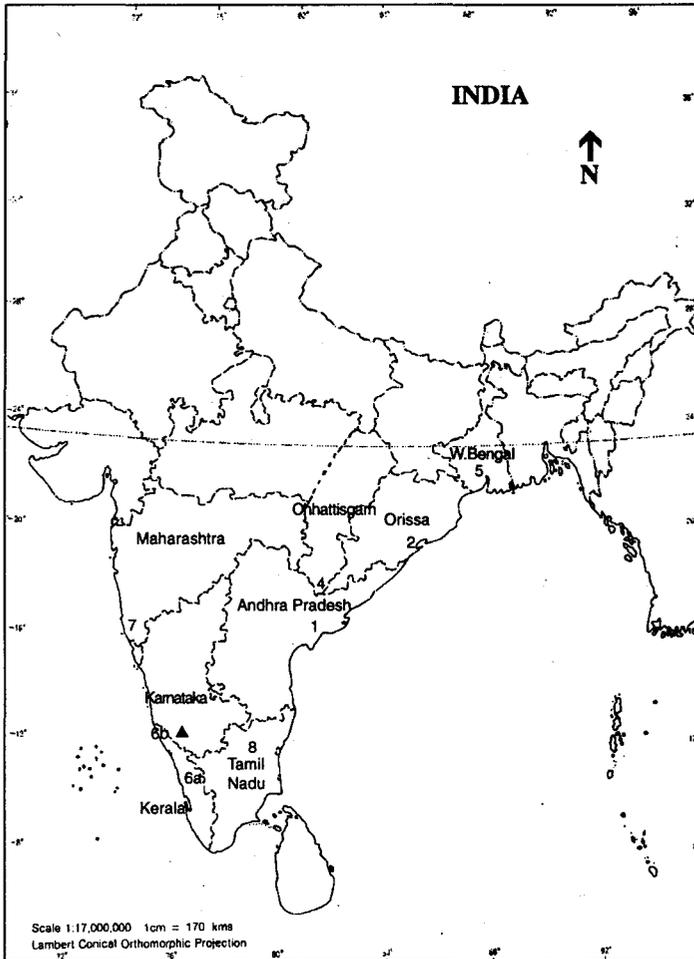
to T3. At Madakkathara, maximum percentage of recovery of infested trees was seen in T1 treatment where neem oil 5% swabbing + *Lindane 0.2%* was given in early and middle stages of infestation. *Swabbing with Metarrhizium anisopliae + 5% neem oil* was also found to be equally effective. Swabbing *Neem oil 5% with 2% Lindane soil* application and swabbing neem oil 5% with *Metarrhizium anisopliae* during early stages was found to be effective in Vengurle. At *Vridhachalam*, extraction of grubs, swabbing of coal tar, soil application of Sevidol and *Metarrhizium anisopliae* in combination during the early stages of attack is found to be most effective.

TRANSFER OF TECHNOLOGY

During the year, 22 demonstration plots have been laid down in farmers field with high density layout. One cashew day and 15 training programmes were conducted by different AICRP centres and also the scientists have participated in various seminars conducted by different agencies. A total of 4,48,848 grafts were produced and distributed to different government and non-government agencies as well as farmers.



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, GUNTUR DISTRICT, ANDHRA PRADESH.
2. CASHEW RESEARCH STATION (OUAT), BHUBANESWAR 751 003, ORISSA.
3. AGRICULTURAL RESEARCH STATION (UAS), CHINTAMANI 563 125, KOLAR DISTRICT, KARNATAKA.
4. ZONAL AGRICULTURAL RESEARCH STATION (IGAU), JAGDALPUR 494 005, BASTAR DISTRICT, CHHATTISGARH.
5. REGIONAL RESEARCH STATION (BCKVV), JHARGRAM 721 507, MIDNAPORE DISTRICT, WEST BENGAL.
6. (a) CASHEW RESEARCH STATION (KAU), MADAKKATHARA 680 656, THRISSUR DISTRICT, KERALA.
(b) REGIONAL AGRICULTURAL RESEARCH STATION (KAU), PILICODE 671 353, KASARAGOD DISTRICT, KERALA.
7. REGIONAL FRUIT RESEARCH STATION (BSKVV), VENGURLE 416 516, SINDHUDURG DISTRICT, MAHARASHTRA.
8. REGIONAL RESEARCH STATION (TNAU), VRIDHACHALAM 606 001, CUDDALORE DISTRICT, 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 (plateau region) 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 800mm 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. At Bapatla the annual average rainfall is 1167cms and the temperature ranges from 17.3°C to 37.8°C, the soil is sandy soil with low in organic matter, medium in N, low in P_2O_5 and K_2O . Average water holding capacity (AWC) of soil is 100 mm and the climate is sub humid (dry). At Bhubaneswar average rainfall is 1167cms and the temperature ranges from 14.3°C to 37.1°C, the soil is red soil, red loamy and laterite. The climate is sub humid (dry), AWC 100 mm. At Jhargram average rainfall is 1622cms and the temperature ranges from 11.3°C to 39.4°C, the soil is red, laterite, shallow depth gravels, low in organic matter, N and high in P_2O_5 and K_2O . The climate is sub humid (dry), AWC 200 mm. Vridhachalam average rainfall is 1215cms and the temperature ranges from 18.7°C to 35.7°C, the soil is red laterite, low in organic matter, N, medium

in P_2O_5 and high in K_2O ; semi arid (dry), AWC 125 mm.

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). Madakkathara receives average rainfall is 3550 cms and the temperature ranges from 22°C to 36.2°C, the soil is laterite (oxisol), medium, low and medium in N, P & K contents. The climate is Per humid and AWC is 150 mm. At Vengurle average rainfall is 2916cms and the temperature ranges from 17.4°C to 32.9°C. Centre is situated at 90 MSL; the soil is Sandy loam to sandy clay loam with high organic matter, N, K and low in P. The climate is humid, AWC is 150 mm.

Maidan tract is characterised by even land. The coordinating centres Chintamani and Jagdalpur fall in this region. Chintamani receives average rainfall is 789cms and the temperature ranges from 13.9°C to 34.5°C. Centre is situated at 300 MSL, the soil is red sandy loam, deficient in N, medium in P_2O_5 and high in K_2O . The climate is semi arid (dry), AWC is 150 mm.



Crop Imp.

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

Summary

During the year 36 accessions were collected by the coordinating centres of which 22 were field planted bringing the total collection to 1128. Among the germplasm accessions evaluated at Bhubaneswar, the maximum yield was recorded in OC - 65 planted in 1993 with a yield of 3.60 Kg tree⁻¹. At Chintamani, the highest yield (16.10 Kg tree⁻¹) was reported for 44/5 ARSC (V-5) planted in 1995. At Jagdalpur, highest yield was recorded for NRC-138 (380g/tree) planted in 1996. Highest yield for JGM 74/6 planted in 1983 (14.79 Kg tree⁻¹) was reported at Jhargram. Among the new germplasm, M 89/2 has given the highest yield of 2.8 Kg tree⁻¹ six years after planting at Vridhachalam. Among the released varieties evaluated, the data indicated that the BPP-9 followed by V-5 showed highest number of bisexual flowers under Bapatla conditions. Among the 24 released varieties tested, maximum yield was observed for BPP-5 (1.60 Kg tree⁻¹) planted in 1990 at Madakkathara.

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 1107 cashew accessions have been conserved and were being maintained in different Centres. During the year 36 accessions were collected by the centres of which 22 were field planted bringing the total to 1128 (Table 1.1).

The details of the centre by which collection has been made, source of collection, number of collections made and salient features are given in Table 1.2.



Table 1.1: Cashew germplasm holding in different centres.

Centre	No. of accessions		
	Existing	Collected during 2000	Total
East Coast			
Bapatla	128	8*	128
Bhubaneswar	40	5	45
Jhargram	118	1	119
Vridhachalam	261	3	264
West Coast			
Madakkathara	134	1	135
Pilicode	64	6*	70
Vengurle	225	12	237
Maidan tract/others			
Chintamani	120	—	120
Jagdapur	10	—	10
Total	1100	36	1128

*These were marked during the year and will be conserved.

Table 1.2: Cashew germplasm collected during 2000 at different States.

State (Centre)	Source of collection	No. of collections	Salient features
Andhra Pradesh (Bapatla)	Petamalapalli, Aswaraopeta	1	High yielding, bold nut types
	Simhachalam Forest Visakhapatnam	2	-do-
	APFDC, Kavali	1	-do-
	Bapatla	3	-do-
	Nandirajuthota Bapatla	1	Includes on dwarf Compact canopy with Semi-vigorous habit
Orissa (Bhubaneswar)	Bhubaneswar	5	Cluster bearing
West Bengal (Jhargram)	Ramnagar, Midnapore	1	Cluster bearing
Tamil Nadu (Vridhachalam)	Veerasingamkuppam	3	High yielding Bold nut types
Kerala (Madakkathara)	NRCC Puttur	1	Purple cashew
Maharashtra (Vengurle)	Ratnagiri Sindhudurg Kolhapur	12	High yielding types
Total		30	



Germplasm evaluation

Evaluation of cashew germplasm at different centres has been carried out during the year 2000. The characteristics of promising accessions in different centres are presented in Table 1.3 - 1.12.

BAPATLA

During the year the plant height, girth

and the canopy spread were recorded. The germplasm accession T.No.71 has recorded highest plant girth of 28.5 cm followed by 5/1 and 10/2 with girth of 28.3 cm. Highest canopy spread was observed in accession 4/3 with 301 cm (E-W) and 310 cm (N-S). The performance of promising accessions is presented in Table 1.3.

Table 1.3: Performance of promising germplasm accessions planted in 1997 at Bapatla.

Accession	Height (cm)	Girth (cm)	Canopy Spread (cm)	
			E-W	N-S
T No.40	133	24.0	201	233
3/4	165	26.6	238	231
4/3	198	25.0	301	310
4/5	186	27.5	288	293
228	151	26.6	225	230
233	143	25.0	208	241
268	188	26.0	285	280
BLA 139/1	153	24.3	216	210
BLA 39/4	188	24.4	262	215
ABT-1	186	21.6	223	213
5/1	205	28.3	265	238
2/3	183	27.6	240	258
10/2	218	28.3	221	241
T.No.71	215	28.5	297	267
277	215	25.2	277	270
6/20	176	22.3	243	240
8/7	194	24.8	262	250
2/14	193	25.0	223	233

BHUBANESWAR

At Bhubaneswar, the maximum yield was recorded in OC - 65 with a yield of 3.60 Kg tree⁻¹ followed by OC-46 with 3.20 Kg tree⁻¹. The yield recorded for promising germplasm accessions is presented in Table 1.4.

CHINTAMANI

At Chintamani, the yield and yield characteristics were recorded during evaluation of germplasm accessions during the year. The highest yield (16.10 Kg tree⁻¹) was reported for 44/5 ARSC (V-5) followed



by 35/3 ARSC (ME 4/4) and maximum shelling percentage (30%) was seen in the latter, with a yield of 16.00 Kg tree⁻¹. The highest nut weight was observed in 41/3 ARSC. The data on promising germplasm accessions are presented in Table 1.5.

Table 1.4: Performance of some germplasm accessions planted in 1993 at Bhubaneswar.

Accession Number	Yield Kg tree ⁻¹
OC-1	2.13
OC-6	2.24
OC-12	1.40
OC-14	2.56
OC-21	1.50
OC-22	2.10
OC-31	2.90
OC-38	1.15
OC-46	3.20
OC-55	1.30
OC-56	2.30
OC-59	1.45
OC-60	1.90
OC-63	3.00
OC-65	3.60
OC-67	2.20

Table 1.5: Performance of promising germplasm accessions planted in 1995 at Chintamani.

Accession Number	Year of Planting	Cumulative Yield (Kg tree ⁻¹)	Yield (Kg tree ⁻¹)	Mean Yield (Kg tree ⁻¹)	Nut Wt. (g)	Shelling %
2/6 ARSC (3/108 Gubbi)	1982	147.60 (15 Yrs)	6.00	9.84	4.10	28.0
35/3 ARSC (ME 4/4)	1985	103.45 (12 Yrs)	16.0	8.24	6.30	30.0
41/3 ARSC (5/37 Manjeri)	1985	128.59 (12 Yrs)	12.0	10.72	7.8	29.5
44/1 ARSC (Vengurla-5)	1985	118.93 (12 Yrs)	0.50	9.91	4.08	27.4
44/5 ARSC (Vengurla-5)	1985	118.50 (12 Yrs)	16.10	9.88	4.08	27.4



JAGDALPUR

At Jagdalpur, highest yield was recorded for NRC-138 (380g tree⁻¹). The plant girth (37.3 cm), canopy spread (2.7x2.4 M)

and plant height (2.0 M) were also found to be more in the same accession. The performance of germplasm at Jagdalpur is presented in Table 1.6.

Table 1.6: Performance of promising germplasm accessions planted in 1996 at Jagdalpur.

Accession No.	Height (m)	Girth (cm)	Canopy Spread (m)		No. of primary branches	Flowering period	Yield (g tree ⁻¹)	Nut Wt. (g)
			N-S	E-W				
NRC-130	1.85	35.33	3.09	3.46	3.5	Mid	150.0	5.25
NRC-131	1.94	30.66	2.87	3.11	3.2	Mid	240.0	4.20
NRC-136	1.90	34.00	2.86	2.66	2.7	Late	160.0	4.70
NRC-137	2.36	35.60	2.02	3.20	4.2	Late	350.0	4.60
NRC-138	2.78	45.50	3.91	3.90	4.5	Early	380.0	4.80
NRC-140	1.96	35.83	3.09	3.00	3.7	Early	190.0	4.30
NRC-190	1.81	32.60	2.03	2.16	3.0	Mid	—	—
NRC-191	2.10	41.20	3.24	3.50	2.8	Mid	270.0	3.20
NRC-192	2.59	40.80	3.60	3.50	3.8	Mid	100.0	3.00
NRC-193	2.04	39.40	3.70	3.60	3.8	Early	305	4.70

JHARGRAM

The evaluation of germplasm accessions indicated highest yield for JGM 74/6 (14.79 Kg tree⁻¹) followed by JGM 66/7 (14.02/kg). The cumulative yield was highest for JGM 66/7 (119.56 Kg tree⁻¹) followed by JGM 80/2 (115.84 Kg tree⁻¹) and JGM 66/7 (112.1 Kg tree⁻¹) for a period

of 13 years. The shelling percentage was however high (39%) for JGM 29/8 JGM 80/2 and JGM 16/1 havinh an average shelling percentage of 33.1% JGM 58/12 recorded a nut weight of 6.3g followed by JGM 31/1 (6.2g). The performance of promising germplasm accessions is presented in Table 1.7.



Table 1.7: Performance of promising germplasm accessions planted in 1983 at Jhargram.

Accession No.	Year of Planting	Cumulative yield (Kg tree ⁻¹) for 13 years	yield (Kg tree ⁻¹)	Nut Wt. (g)	Shelling %
JGM 1/4	1983	89.20	12.43	5.8	31.0
JGM 10/3	1983	72.12	10.11	4.9	33.1
JGM 11	1983	64.60	12.51	5.7	32.2
JGM 16/1	1983	101.76	12.68	5.5	33.1
JGM 17/1	1983	94.51	10.80	5.3	31.5
JGM 19/1	1984	94.74	11.45	5.2	30.6
JGM 20/6	1983	92.46	11.80	5.5	32.7
JGM 29/8	1984	81.24	10.39	6.0	39.0
JGM 31/1	1984	85.65	12.14	6.2	30.2
JGM 48/4	1985	92.59	10.45	5.5	32.1
JGM 58/12	1985	85.93	13.46	6.3	30.5
JGM 66/7	1983	112.10	14.02	5.3	29.8
JGM 74/6	1983	119.56	14.79	6.1	29.5
JGM 79/5	1984	94.31	10.21	5.1	32.0
JGM 80/2	1984	115.84	13.51	4.8	33.1

MADAKKATHARA

The highest yield recorded was 3.1 kg for H 1600 followed by 2.19 kg for H-3-17. The boldest nut (10.3g) was observed in Brazil 239 followed by H-8-6 (9.37g), apple weight was also more (100g) for the same accession. However, cumulative yield was maximum (18.24 Kg tree⁻¹) in Anakkayam-1 for ten harvests (Table 1.8).

PILICODE

Observations on growth parameters of grafts planted during 1996 in the cashew germplasm were carried out (Table 1.9). Vigorous growth was shown by the accession PCKC 9 with 4.75 m height, 45.5 cm stem girth, highest spread (4.81m N-S and 4.81m E-W) and highest number of secondary branches (10.3).



Table 1.8: Performance of promising germplasm accessions at Madakkathara.

Year of planting/ Accession No.	Yield		Nut Wt. (g)	Apple Wt. (g)
	Current Year (Kg tree ⁻¹)	Cumulative (Kg tree ⁻¹)		
1988				
Brazil 239	0.65	6.85	10.30	100
Brazil 244	1.50	6.00	6.40	80
Anakkayam-1	2.04	18.24	3.98	32
BLA 39-4	1.25	12.65	5.05	58
K 22-1	1.025	8.325	5.30	40
H 3-13	1.23	9.83	4.50	48
H 3-17	2.19	11.79	5.13	45
1989				
H 680	1.27	6.57	4.83	56
H 718	1.08	5.98	5.20	54
H 1589	1.73	12.03	8.70	71
H 1596	1.05	11.25	7.07	45
H 1600	3.10	12.10	7.18	45
A 6-1	1.10	7.10	7.10	60
K 16-1	1.08	4.08	7.30	54
H 7-6	1.10	10.00	6.10	70
H 8-6	0.60	6.40	9.37	48
H 8-8	1.62	5.02	8.13	50
H 9-3	1.68	6.18	7.10	50
1993				
Vetore - 56	1.13	2.53	5.10	50

Table 1.9: Growth observations on germplasm at Pilicode in grafts planted during 1996

Accession	Height (m)	Stem Girth (cm)	Canopy Spread (m)		Number of branches	
			N-S	E-W	Primary	Secondary
PCKC 4	4.51	44.56	4.28	4.06	2.67	6.33
PCKC 8	4.70	46.40	3.73	3.66	2.70	8.70
PCKC	9 4.75	45.50	4.19	4.81	2.30	10.30
BM 1	3.38	38.00	2.81	3.38	2.60	6.40
OCT	2 3.23	36.50	3.01	3.35	2.50	7.00
BLM	3 2.75	35.50	2.13	2.38	2.00	5.50
BLM 2	2.88	30.00	1.88	2.88	2.50	7.00
KM	2.63	3.15	2.68	2.58	1.50	6.00
PCKC 1	2.77	15.67	1.60	1.80	1.00	6.00
TPB	1.70	23.40	2.10	2.15	9.00	11.00

**VENGURLE**

A total of 161 elite types of cashew and 74 bold nut types are present in the germplasm collection at the Centre. In 1993, bold nut types from ICAR Research Complex, Goa were collected and field planted in 1994. Highest yield was obtained from the variety Bali-2 (4.530 Kg tree⁻¹) seven years after planting. The data on these bold nut types is presented below in Table 1.10.

VRIDHACHALAM

All the 264 accessions were evaluated

for identifying high yielding varieties with export quality kernels. Among the new germplasm, M 89/2 has given the highest yield of 2.8 Kg tree⁻¹ followed by M 79/4 with 2.0 Kg tree⁻¹. The data on performance of promising germplasm accessions is presented in Table 1.11. Among the old germplasm accessions conserved at the Centre, M 15/4 showed highest yield of 3.25Kg tree⁻¹ followed by M 6/1 and M 26/4 with 1.8 Kg tree⁻¹ each. The detail of the performance of promising old germplasm accessions is given in Table 1.12 .

Table 1.10: Performance of germplasm accessions planted in 1994 from Goa at Vengurle

Accession	Yield Kg tree ⁻¹		Cumulative yield for 2 harvests	Nut Wt (g)	Shelling (%)
	2000	2001			
Bali-1	1.160	1.190	2.350	6.00	29
N.P.	1.580	2.170	3.720	7.5	25
Palkul	1.500	1.500	3.000	6.5	27
Bali-2	3.500	4.530	8.030	6.5	24
Balkul	1.450	4.530	5.980	8.5	29
Permagudi	0.850	0.320	1.170	8.5	26
Dodamarg	1.600	2.300	3.900	7.5	27
Nanaoda-2	1.500	1.750	3.250	8.5	24

Table 1.11 : Performance of promising new germplasm accessions at Vridhachalam

Accession No.	Year of planting	Flowering habit	Tree canopy (cm)		Apple weight (gm)	Apple colour	Nut weight (g)	Shelling (%)	Yield Kg tree ⁻¹
			N.S	E.W					
ME 20/1	1994	Mid	6.15	6.50	30	Pink	4.9	28.5	1.000
M 69/4	1994	Mid	3.62	4.17	40	Y. /R.S	5.9	27.1	1.750
M 70/1	1994	Mid	4.77	5.05	45	Pink	6.6	27.3	1.750
M 79/4	1994	Mid	5.50	5.60	30	Pink	5.9	23.7	2.000
M 89/2	1994	Late	5.10	5.52	15	Yellow	3.4	26.4	2.800
M 87/3	1994	Mid	5.75	6.67	35	Yellow	5.7	28.1	1.500
TAF 5	1994	Mid	3.45	3.95	30	Pink	5.5	27.2	1.525



Table 1.12 : Performance of promising old germplasm accessions at Vrindhachalam

Accession No.	Year of planting	Nut weight (g)	Shelling (%)	Yield Kg tree ⁻¹
M 4/3	1989	4.6	25.6	1.500
M 26/4	1989	5.7	27.0	1.800
M 37/3	1989	6.5	27.2	0.900
M 63/4	1989	5.6	29.1	0.900
M 46/2	1989	6.1	24.2	1.500
M 6/1	1989	6.1	28.1	1.800
M 15/4	1989	5.8	29.5	3.250

3. Performance of released varieties

BAPATLA

Among the released varieties, which were evaluated in experiment, BPP-8,

Priyanka and BPP-2 were found to be vigorous types. The following data indicated that the BPP-9 followed by V-5 showed highest number of bisexual flowers (Table 1.13).

Table 1.13 : Evaluation of released varieties at Bapatla

Variety	Height (cm)	Spread (cm)		Girth (cm)	No. of flowers		
		E-W	N-S		Male	Bisexual	Total
BPP-1	130	240	242	22.0	375.25	60.25	435.50
BPP-2	163	280	258	24.6	389.25	64.50	453.75
BPP-3	154	226	250	21.8	308.00	57.50	365.50
BPP-4	180	210	222	23.7	240.25	80.50	420.75
BPP-5	177	190	217	16.5	359.75	76.00	435.75
BPP-6	123	180	173	18.0	422.25	65.75	478.00
BPP-8	165	225	280	24.5	330.25	57.50	387.75
BPP-9	106	170	210	15.6	374.75	129.00	503.75
Kanaka	140	193	243	20.0	140.00	83.00	223.00
Dhana	120	190	196	18.3	156.75	67.10	223.80
Priyanka	163	263	260	19.6	NA	NA	NA
Chintamani	90	90	86	8.0	NA	NA	NA
VRI-1	130	196	250	23.2	NA	NA	NA
VRI-2	130	196	250	20.6	NA	NA	NA
VRI-3	146	232	234	23.2	NA	NA	NA
Vengurla-1	152	206	192	24.8	279.50	72.50	352.00
Vengurla-2	160	185	200	22.2	334.75	68.25	403.00
Vengurla-3	172	172	180	21.2	108.00	43.00	151.00
Vengurla-4	192	224	220	23.4	132.75	37.75	170.50
Vengurla-5	180	192	224	26.0	253.25	85.50	338.75
Vengurla-6	70	73	73	7.3	NA	NA	NA
Jhargram-1	85	105	108	8.6	NA	NA	NA
BBSR-1	146	150	136	17.0	159.00	47.50	206.50
Ullal-1	64 60	66	6.4	NA	NA	NA	NA
Ullal-4	102	107	105	11.2	NA	NA	NA
UN - 50	110	116	110	13.6	NA	NA	NA

**JAGDALPUR**

Among the 14 released varieties tested, Vengurla-4 with 1.0 Kg tree⁻¹ followed by Ullal-2 with 0.802Kg tree⁻¹ performed well. H 1591 was found to be a spreading and vigorous type. Details of the observations made are given in Table 1.14.

MADAKKATHARA

Among the 24 released varieties tested, maximum yield was observed for BPP-5 (1.60 Kg tree⁻¹) followed by BPP-2 and BPP-3 (1.48 Kg tree⁻¹) in the tenth year after planting (Table 1.15).

Table 1.14 : Evaluation of released varieties at Jagdalpur

Variety	Height (m)	Girth (cm)	Canopy spread (m)		No. of primary branches	Flowering period	Yield (kg tree ⁻¹)	Nut Wt. (g)
			E-W	N-S				
BPP-2	0.9	16	0.9	1.0	4.0	NA	NA	NA
BPP-4	1.1	17	1.0	1.0	NA	NA	NA	NA
BPP-8	0.3	4	NA	NA	NA	NA	NA	NA
Vengurla-1	2.3	32	3.2	3.2	4.2	Mid	0.50	6.6
Vengurla-4	5.5	55	4.4	6.0	6.0	Early	1.00	5.3
Ullal-1	2.8	45	5.0	5.3	6.5	Mid	0.28	5.1
Ullal-2	3.3	43	3.9	3.8	4.8	Mid	0.80	4.9
H 1591	3.3	55	5.0	5.0	4.0	Mid	0.63	4.0
Kanaka	2.8	43	3.5	4.0	4.0	Mid	0.58	6.8
Dhana	2.6	46	3.9	3.9	5.0	Late	0.50	5.5
BLA 39-4	2.5	41	3.4	3.6	5.1	Mid	0.34	4.3
K 22-1	2.5	39	3.8	3.8	5.2	Late	0.40	4.7
Chintamani-1	1.1	11	0.7	0.6	3.3	NA	NA	NA
NDR 2-1	2.4	37	3.1	3.2	6.0	Mid	0.33	6.1



Table 1.15: Evaluation of released varieties planted in 1990 at Madakkathara

Variety	Year of Planting	Canopy type	Yield (Kg tree ⁻¹)	Nut wt. (g)	Flowering season
BPP-1	1990	Semi erect	0.917	4.6	Mid
BPP-2	1990	Semi erect	1.480	3.98	Mid
BPP-3	1990	Semi erect	1.480	4.90	Mid
BPP-4	1990	Semi erect	0.900	4.72	Mid
BPP-5	1990	Semi erect	1.600	4.33	Mid
BPP-6	1990	Semi erect	0.500	5.05	Late
Vengurla-1	1990	Semi erect	NA	NA	Mid
Vengurla-2	1990	Semi erect	1.450	4.28	Mid
Vengurla-3	1990	Semi erect	0.730	5.85	Late
Vengurla-4	1990	Semi erect	0.300	7.29	Mid
Vengurla-5	1990	Semi erect	1.600	4.79	Mid
Vengurla-6	1993	Semi erect	NA	NA	Mid
VTH-711	1991	Semi erect	0.900	7.00	Mid
VTH-711/4	1991	Semi erect	0.650	NA	Mid
Jhargram-1	1991	Semi erect	NA	NA	Late
Rajapalayam	1991	Semi erect	NA	NA	Late
NRCC Sel-1	1991	Semi erect	NA	NA	Late
NRCC Sel-2	1993	Semi erect	NA	NA	Late
Ullal-1	1997	Semi erect	NA	NA	NA
Ullal-2	1997	Semi erect	NA	NA	NA
Ullal-3	1997	Semi erect	NA	NA	NA
Ullal-4	1997	Semi erect	NA	NA	NA
UN-50	1997	Semi erect	NA	NA	NA
Goa 11/6	1998	Semi erect	NA	NA	NA



Crop Imp.

Varietal evaluation**Gen. 3****Expt.1: Comparative yield trial (CYT)****Centre** Maidan tract : Chintamani**Summary**

The nut yield was highest in Vengurla-3 (11.08 Kg tree⁻¹) at Chintamani under comparative yield trial planted in 1986.

The Objective is to evaluate the performance of varieties of Bapatla and Vengurle centres.

Experimental details:

Design : RBD
Replication : Three

Varieties :

Bapatla : BPP-1, BPP-3, BPP-4, BPP-5, BPP-6
Vengurle : V-1, V-2, V-3, V-4, and V-5

At Chintamani, the trial was started during 1986 and the data on plant growth, yield and nut parameters are furnished in the Table 1.16. V-3 recorded highest plant height (6.1 m) and stem girth (104.89 cm). The nut yield was highest in V-3 (11.08 Kg tree⁻¹) followed by V-5 (10.24 Kg tree⁻¹). The

cumulative yield was highest in the variety V-5 (59.64 Kg tree⁻¹) followed by Bapatla-6 (47.89 Kg tree⁻¹). The highest nut weight (6.11g) was recorded for V-4. The shelling percentage was high in Vengurla-4 and V-1 (29.5% and 28.5% respectively).

Table 1.16: Performance of varieties under planted in 1986 at Chintamani.

Variety	Height (m)	Girth (cm)	Canopy shape	Yield Kg tree ⁻¹	Cum. yield for 11 years	Flowering period years	Nut wt (g)	Shelling (%)
V-1	5.26	94.78	Compact	5.69	31.98	Medium	5.77	28.5
V-2	5.54	86.50	Medium	4.11	34.90	Long	4.62	27.9
V-3	6.10	104.89	Sparse	11.09	46.11	Medium	5.91	25.1
V-4	4.99	78.57	Sparse	60.02	29.57	Medium	6.11	29.5
V-5	5.34	86.05	Compact	10.24	59.64	Medium	4.42	24.9
BPP-1	5.43	79.47	Compact	6.73	29.94	Medium	4.90	28.1
BPP-3	5.67	92.64	Medium	4.62	27.80	Medium	4.95	27.7
BPP-4	6.06	95.50	Medium	3.28	28.08	Long	4.91	27.7
BPP-5	5.41	84.47	Compact	3.48	33.89	Medium	5.27	27.6
BPP-6	5.79	101.30	Compact	8.79	47.89	Medium	5.73	27.8
SEM±	0.24	3.33		2.40				
CD at 5%	NS	9.88		NS				
CV (%)	7.7	6.4		62.9				



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

Centres	East Coast	:	Bhubaneswar and Jhargram
	West Coast	:	Madakkathara
	Maidan tract	:	Chintamani

Summary

The Multi location trial (MLT) 86 was started during 1986 at Chintamani and Vengurle and during 1987 at Bhubaneswar, Jhargram, Madakkathara and Vridhachalam. However, due to cyclone in 1999 the trial was completely damaged at Bhubaneswar and was discontinued. During the year under MLT 86 the yield was significantly high in M 44/3 (5.93 Kg tree⁻¹) at Chintamani. Highest nut yield per tree was recorded for H 2/16 (8.80 kg tree⁻¹) at Jhargram. Highest yield was reported for V-5 (12.56 Kg tree⁻¹) from Madakkathara.

The objective is to evaluate performance of high yielding varieties in different locations.

Experimental details:

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

BHUBANESWAR

The experimental plot was damaged during the super cyclone on 29th October 1999 and the experiment has been discontinued.

CHINTAMANI

The trial was started in 1986 with 19 varieties. During the year the yield was significantly high in M 44/3 (5.93 Kg tree⁻¹) compared to the next highest H 1610 (5.40 Kg tree⁻¹). The cumulative yield was highest in M 44/3 for eleven harvests (49.01 Kg tree⁻¹). Shelling percentage was also high

in the same variety (30.5%) whereas the nut weight was highest in H 1608 (7.99 g) followed by Vengurle-3 (7.94 g). The data is presented in Table 1.17.

JHARGRAM

Plant growth was more in VTH 30/4, which recorded 7.03 m height and 94.81 cm girth. Highest nut yield per tree was recorded in H 2/16 (8.80 kg) followed by VTH 59/2 (6.4 Kg tree⁻¹). VTH 59/2 has shown highest cumulative yield (61.56 Kg tree⁻¹) over a period of 13 years. The growth parameters and yield performances are presented in Table 1.18.



• Table 1.17: Performance of varieties under planted in 1986 at Chintamani

Variety	Height (m)	Girth (cm)	Canopy Shape	Yield (Kg tree ⁻¹) 9TH Harvest	Cum. yield (Kg tree ⁻¹) for 9 harvests	Nut Wt. (g)	Shelling %
H 1598	5.02	80.11	Medium	4.53	31.65	5.27	24.7
H 1600	4.85	85.83	Compact	4.23	36.95	6.33	28.1
H 1608	4.73	85.45	Medium	3.99	39.10	7.99	28.4
H 1610	5.03	94.52	Medium	5.40	38.12	7.38	28.0
TN 129	5.06	79.17	Medium	3.67	30.84	5.22	28.3
TN 40	4.64	88.22	Compact	2.60	26.87	4.65	29.6
H 2/15	4.69	74.47	Compact	4.03	31.69	6.97	27.7
H 2/16	4.86	81.30	Sparse	2.93	27.81	7.32	24.6
V-2	4.24	74.00	Sparse	5.26	30.20	4.33	29.5
V-3	4.99	80.17	Sparse	3.73	30.97	7.94	28.0
V-4	4.68	82.07	Sparse	4.32	31.30	6.15	27.1
H 24	5.08	82.60	Compact	5.11	37.93	4.30	28.0
M 44/3 (Vengurla)	4.46	66.28	Compact	3.27	21.98	4.91	28.7
M 44/3(VRI)	4.47	78.40	Compact	4.78	49.01	4.34	28.8
M 44/3(VTH 12)	4.59	70.33	Compact	5.93	32.62	5.07	30.5
M 30/4(VTH 30)	4.71	78.20	Medium	2.25	24.90	6.09	24.9
M 59/2(VTH 59)	4.63	86.68	Sparse	2.30	29.90	4.63	30.1
SE m±	0.24	3.96		1.11			
CD (P=0.05)	NS	11.43		NS			
CV%	8.87	8.54		48.05			

Table 1.18: Performance of varieties under MLT 86 planted in 1987 at Jhargram

Variety	Height (m)	Girth (cm)	Canopy Shape	Yield (Kg tree ⁻¹)	Cum. Yield (13 yrs.) (Kg tree ⁻¹)	Nut Wt. (g)	Shelling (%)
VTH 30/4	7.03	94.81	Compact	5.80	49.17	6.2	28.53
VTH 59/2	5.31	74.92	Medium	6.40	61.56	6.0	30.13
H 2/15	5.60	72.27	Compact	5.87	48.21	6.75	30.73
H 2/16	5.41	81.89	Medium	8.80	58.17	6.61	30.50
TN 40	5.58	74.56	Compact	5.45	42.39	6.25	29.55
TN 129	5.92	66.39	Medium	5.32	41.75	4.83	28.35
H 1608	5.12	74.56	Compact	3.50	30.95	5.00	29.40
H 1598	4.59	70.04	Medium	4.55	38.72	7.33	30.40
H 1600	3.83	56.41	Medium	4.25	35.20	5.53	31.23
H 1610	5.80	94.56	Medium	5.00	35.72	5.00	29.50
M 26/2	4.77	62.71	Sparse	4.85	34.81	5.94	30.37
M 33/3	5.16	63.65	Medium	6.05	46.29	6.50	29.13
M 44/3	4.27	54.37	Semi dwarf	4.50	31.57	5.58	30.02
SE m±	0.025	0.011		0.025		NS	0.348
CD at 5%	0.052	0.022		0.051			0.718



MADAKATHARA

Maximum height and girth were observed in H 1610 (9.35 m, 138.1 cm respectively). Highest canopy spread was observed in V-3 (12.48 m) followed by H 1610

(12.37 m). However, highest yield was obtained for V-5 (12.56 Kg tree⁻¹) followed by V-3 (12.13 Kg tree⁻¹). The growth and yield performance of different varieties is presented in Table 1.19.

Table 1.19: Performance of varieties under MLT 86 planted in 1987 at Madakkathara.

Variety	Height (m)	Girth (cm)	Canopy Spread(m)	Yield (Kg tree ⁻¹) 9th Harvest	Cum. yield (Kg tree ⁻¹) for 9 harvests
H 1598	8.51	105.9	10.84	8.04	85.12
H 1600	7.68	103.7	11.18	3.32	64.44
H 1608	6.94	95.3	9.99	5.83	70.45
H 1610	9.35	138.1	12.37	2.29	36.42
T 30/4	7.73	99.5	10.44	11.51	70.65
T 59/2	7.63	99.66	10.43	3.46	42.93
T 129	7.84	102.5	11.26	8.28	38.25
T 40	7.70	92.35	9.87	4.39	38.64
H 2/15	7.37	88.96	10.04	5.83	50.59
H 2/16	7.52	95.83	11.59	6.27	42.99
V-2	7.59	73.2	8.53	0.90	30.42
V-3	9.13	112.8	12.48	12.13	68.84
V-4	8.32	91.33	10.37	7.71	60.84
V-5	7.49	95.91	10.83	12.56	85.42
M 33/3	7.36	87.60	9.81	4.05	56.56
M 44/3	6.69	73.41	8.93	8.37	80.99
M 26/2	7.45	97.63	9.64	5.71	85.77
AKM-1	6.64	82.0	9.01	5.04	68.22
SEm±	0.4	4.81	0.47	1.14	
CD	0.81	9.83	0.95	2.32	

**Expt. 3 : Multilocation 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

Summary

Among the varieties tested under MLT - 92, highest yield was obtained for variety 30/1 (2.80 Kg tree⁻¹) planted at Bapatla during 1993. Maximum yield was obtained for H 367 (5.64 Kg tree⁻¹) planted in 1992 at Bhubaneswar. At Chintamani, maximum plant height (4.98 m) and maximum yield (5.52 Kg tree⁻¹) were recorded for Hy 302 planted in 1992. Maximum plant height (2.90 m) and yield (1.59 Kg tree⁻¹) were observed in H 303 planted in 1997 at Jagdalpur. At Madakkathara, the highest yield was obtained from M 15/4 (21.90 Kg tree⁻¹) planted in 1993. Highest plant girth and highest yield (6.976 Kg tree⁻¹) was obtained in M 15/4 planted in 1994 at Vridhachalam.

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

Experimental details :

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

BAPATLA

During the year maximum plant height, girth canopy spread and nut weight were recorded in T.NO. 10/19 (4.32 m, 66.5 cm, 6.35 m EW, 7.00 m NS, 7.2g respectively). The flowering intensity was more in Hy 367

followed by Hy 303. Highest yield was obtained for variety 30/1 (2.80 Kg tree⁻¹). The cumulative yield was higher in M-44/3 (13.013 Kg tree⁻¹) followed by M 15/4 (12.56 Kg tree⁻¹). The data on growth, flowering characteristics and yield are presented in Table 1.20.

BHUBANESWAR

Maximum number of flowering panicles was recorded in BPP 3/33 (44.50). However, maximum yield was obtained for H 367 (5.64 Kg tree⁻¹) and highest cumulative yield was obtained for H 320 (20.06 Kg tree⁻¹) followed by BPP 30/1 (19.40 Kg tree⁻¹). Maximum shelling percentage was found in H 255 (33.82%). The data is presented in the Table 1.21.

CHINTAMANI

During the year maximum plant height

(4.98 m) and maximum yield (5.52 Kg tree⁻¹) were recorded for Hy 302 followed by Hy 255 in plant height (4.70 m) while maximum stem girth (77.42 cm) was recorded for NRCC-1. However, highest cumulative yield for six years was recorded for NRCC-2 (18.54 Kg tree⁻¹). Highest nut weight was observed in Hy 255 (8.27 gm) and highest shelling percentage was recorded in NRCC-1 (30.7%). The data on growth and yield characteristics of varieties under MLT-92 is presented under Table 1.22.

Table 1.20 : Performance of varieties under MLT 92 planted in 1993 at Bapatla

Variety	Height (m)	Girth (cm)	Canopy Spread (m)		Yield (kg tree ⁻¹)	Cum. yield (Kg tree ⁻¹) for 5 harvest	Flowering period	No. of fruits panicle ⁻¹	Nut Wt (g)	Shelling (%)
			EW	NS						
3/28	3.90	53.8	5.2	5.3	1.9	8.946	Mid	3.2	6.6	25.6
3/33	3.70	53.4	5.25	5.15	1.65	7.115	Mid	3.4	5.0	26.0
10/19	4.32	66.5	6.35	7.00	2.8	12.465	Mid	4.0	7.2	24.8
30/1	3.8	52.2	5.10	4.95	2.6	9.628	Early	3.6	5.4	26.8
Hy 68	3.65	51.4	4.70	4.90	2.6	9.628	Mid	2.6	6.2	24.0
Hy 367	3.60	47.6	5.35	5.38	1.08	5.748	Mid	3.0	6.6	24.0
Hy 303	3.7	48.4	4.55	4.70	1.12	5.537	Early	3.2	6.8	24.4
Hy 255	3.3	45.4	4.35	4.5	0.86	3.128	Mid	2.4	6.4	24.4
Hy 320	3.62	51.4	5.24	5.30	1.1	5.11	Mid	2.6	7.2	25.2
M 44/3	4.1	55.4	5.38	4.46	3.3	13.013	Early	4.8	3.4	26.4
M 15/4	4.2	57.7	5.02	4.72	2.6	12.56	Early	4.6	6.6	26.0
107/3	3.64	45.4	5.10	4.85	1.4	6.737	Mid	3.0	6.2	25.0
40/1	3.95	53.6	4.90	5.15	1.2	7.021	Early	3.6	5.8	25.2

Table 1.21: Flowering and yield in varieties under MLT planted in 1992 at Bhubaneswar.

Variety	Plant height (m)	Plant girth (cm)	Canopy spread (m)		Yield (Kg tree ⁻¹)	Cum. yield (Kg tree ⁻¹) 5th harvest	No. of fruits panicle ⁻¹	Nut Wt (g)	Shelling %
			E-W	N-S					
NRCC-1	3.50	45.55	5.23	5.43	1.59	7.02	3.08	7.02	33.33
NRCC-2	3.75	54.17	6.30	6.47	3.15	12.72	5.75	8.87	31.12
M 44/3	2.88	42.33	4.50	4.70	2.08	9.75	3.50	5.30	31.70
M 15/4	4.46	68.33	7.60	7.33	1.83	10.57	5.50	6.27	32.35
BPP 3/33	4.40	72.33	7.77	6.77	2.79	12.90	2.94	5.75	32.00
BPP 10/19	4.55	75.56	8.37	7.90	1.94	10.60	7.17	6.17	28.66
BPP 30/1	4.44	69.58	7.43	7.40	3.25	19.40	3.72	5.83	31.65
BPP 3/28	4.92	72.50	7.20	7.87	2.90	13.51	7.50	7.18	30.76
H 303	4.58	72.08	7.63	6.93	3.21	19.01	5.50	8.60	31.36
H 320	5.50	74.25	6.97	7.00	4.43	20.06	3.14	7.67	29.53
H 255	5.04	83.19	8.57	8.23	3.90	14.23	3.14	9.17	33.82
H 367	4.11	65.00	7.53	8.10	5.64	13.58	3.92	9.95	32.42
H 68	5.09	75.00	7.20	7.47	2.18	11.78	4.17	8.18	29.32
SE m±					0.67				
CD 5%					1.95				

Table 1.22: Flowering and yield characteristics under MLT planted in 1992 at Chintamani.

Variety	Height (m)	Girth (cm)	Canopy Shape	Yield (Kg tree ⁻¹)	Cum. yield (Kg tree ⁻¹) 6 harvests	Nut Wt (g)	Shelling %
Hy 68	--	--	Compact	--	--	7.51	25.2
Hy 367	--	--	Medium	--	--	7.96	29.6
Hy 302	--	--	Medium	5.52	15.04	7.34	27.7
Hy 255	4.70	--	Medium	--	5.26	8.27	29.8
Hy 320	4.98	--	Medium	5.15	12.60	7.98	27.8
M 44/3	3.45	43.06	Compact	--	13.75	5.01	28.6
M 15/4	--	--	Compact	--	--	5.87	28.5
NRCC-1	--	77.42	Compact	5.15	12.29	6.64	30.7
NRCC-2	--	--	Sparse	--	18.54	5.33	27.0
T 30/1	--	--	Compact	--	--	4.69	29.0
T 3/33	--	--	Compact	1.00	6.46	6.25	27.4
T 10/19	--	--	Compact	--	3.45	4.81	30.0
T 3/28	--	--	Compact	0.80	--	6.56	28.2
Ullal-1	--	--	Medium	--	--	6.06	29.3



JAGDALPUR

Maximum plant height (2.90 m), stem girth (55.3 cm) and yield (1.59 Kg tree⁻¹) were observed in H 303. Canopy spread was maximum in H 367. The data on flowering and yield characteristics is presented in Table 1.23.

JHARGRAM

Maximum plant height (4.45 m) and stem girth (47.6 cm) were observed in H 255. Least height was noticed in M 44/3 (2.31 m). The data on growth characteristics of different varieties is presented in Table 1.24.

Table 1.23: Flowering and yield characteristics under MLT 92 planted in 1997 at Jagdalpur

Variety	Height (m)	Girth (cm)	Canopy Shape		Yield (Kg tree ⁻¹)	Flowering period	Nut Wt (g)
			NS	EW			
3/28	2.47	42.0	3.6	4.2	--	Late	--
3/33	1.65	22.0	1.7	1.6	--	--	--
10/19	1.00	20.0	1.7	1.8	--	--	--
30/1	2.10	33.0	3.3	2.9	0.29	Mid	4.4
M 15/4	0.90	13.0	1.0	0.7	0.34	Early	4.8
M 44/3	2.10	29.4	3.0	3.0	1.00	Late	5.2
NRCC-1	2.70	42.5	3.2	3.6	0.39	Early	4.2
NRCC-2	2.00	31.4	2.9	3.0	0.42	Early	5.5
H 68	2.70	45.0	4.9	4.5	0.70	Late	6.0
H 303	2.90	55.3	4.1	4.1	1.59	Late	5.0
H 367	2.60	54.1	6.5	5.5	0.30	Late	5.8

Table 1.24: Growth performance of different varieties under MLT-92 at Jhargram.

Varieties	Height (m)	Girth (cm)
T 30/1	2.76	26.2
T 3/33	2.87	29.7
H 303	2.88	42.2
H 255	4.45	47.6
H 320	3.92	38.4
M 44/3	2.31	22.6
NRCC-2	2.60	26.8

**MADAKKATHARA**

Maximum tree height was observed in 107/3 (5.94 m), maximum girth was also recorded in the same variety (71.00 cm). Highest canopy spread was observed in 3/33 (6.09 m). Minimum plant height was observed in HY 367 (4.14 m). Highest yield was obtained from M 15/4 (21.90 Kg tree⁻¹). The data on growth and yield characteristics is presented in Table 1.25.

VENGURLE

Maximum tree height was observed in H 320 (1.43 m). NRCC Selection 2 has recorded minimum tree height (1.13 m). Maximum girth was recorded in H 367 (0.19 m). The canopy spread was maximum in Hy 367. The vegetative growth data is presented in Table 1.26.

Table 1.25: Growth and yield characteristics under MLT planted in 1993 at Madakkathara.

Variety	Height (m)	Girth (cm)	Canopy spread (m)	Yield (Kg tree ⁻¹)
T 30/1	5.10	61.75	5.22	1.43
T 3/33	5.72	62.75	6.09	1.55
T 10/19	4.81	54.86	4.77	2.45
T 3/28	4.96	58.25	5.80	0.70
H 68	4.93	57.25	4.51	1.13
H 367	4.14	53.75	5.55	1.35
H 303	5.14	51.12	3.43	1.82
H 255	4.66	52.13	4.76	1.90
H 320	4.64	52.13	4.45	1.00
M 44/3	4.99	52.46	5.60	1.55
M 15/4	4.75	66.75	6.00	2.90
NRCC-1	5.94	71.00	5.59	0.95
NRCC-2	4.54	59.13	5.33	2.40
Dhana	5.07	68.13	5.82	1.62
SEm±	0.22	1.42	0.17	0.13
CD	0.45	2.90	0.34	0.26

VRIDHACHALAM

Maximum plant height was observed in NRCC Sel. 1 (4.19m) and minimum height was observed in T. No. 3/33 (2.73 m). Highest plant girth was observed in M 15/4 and highest yield was obtained in M 15/4

(2.32 Kg tree⁻¹ and cumulative yield (6.976 Kg tree⁻¹). The shelling outturn was below 30% in all the varieties. However, maximum shelling percentage (26.1%) was observed in T. No. 10/19. The growth and yield data are presented in Table 1.27.



Table 1.26: The growth parameters of different varieties under MLT-92 at Vengurle.

Variety	Height (cm)	Girth (cm)	Canopy spread (m)	
			N - S	E - W
H 255	1.17	0.16	1.06	1.28
H 303	1.30	0.17	0.88	0.88
H 320	1.43	0.17	1.47	1.51
H 367	1.28	0.19	1.84	1.73
NRCC - 1	1.37	0.14	1.13	1.03
NRCC - 2	1.13	0.16	1.30	1.25
M 44/3	1.15	0.16	1.39	1.49
M 15/4	1.17	0.14	0.90	0.81
10/19	1.20	0.16	1.29	1.41
3/28	1.18	0.12	0.78	0.83
3/33	1.36	0.15	1.23	0.93
30/1	1.36	0.17	1.01	1.43

Table 1.27: Performance of different varieties under MLT planted in 1994 at Vridhachalapuram.

Variety	Height (m)	Girth (cm)	Canopy Spread (m)		Yield (kg Tree ⁻¹)	Cum. yield (Kg tree ⁻¹)	Flowering period	No. of fruits	Nut Wt (g)	Shell %
			N-S	E-W						
T 30/1	3.29	35.3	4.44	4.66	0.260	1.915	Early	2.5	7.0	20.0
T 3/33	2.73	34.7	4.05	3.91	0.400	2.485	Late	1.5	8.0	20.0
T 10/19	3.88	44.3	5.28	5.49	0.525	1.686	Mid	2.0	7.0	26.0
T 3/28	3.70	43.0	5.14	4.98	0.800	2.712	Late	1.0	7.0	23.0
H 68	3.32	38.8	6.06	4.81	0.900	3.417	Late	2.0	7.4	20.0
H 367	3.33	45.9	6.29	5.81	0.587	3.042	Mid	2.0	7.0	14.0
H 303	3.78	42.5	4.95	4.66	0.800	3.382	Late	3.0	8.0	22.0
H 255	3.34	48.1	5.69	5.77	--	1.812	Mid	--	--	--
H 320	3.72	45.4	5.91	5.70	0.668	3.418	Mid	1.5	8.3	20.0
M 44/3	3.24	40.2	4.90	4.97	2.310	6.408	Early	3.0	5.3	23.0
M 15/4	3.73	52.6	6.10	6.20	2.320	6.976	Early	4.0	6.3	22.0
NRCC-1	4.19	51.0	5.96	5.95	0.600	1.649	Late	2.0	6.9	16.0
NRCC-2	3.49	39.1	4.67	4.76	0.920	4.155	Mid	2.5	9.2	21.0



Crop Imp.

Gen. 4

Hybridisation and selection

Centres	East Coast	:	Bapatla, Bhubaneswar, Jhargram and Vridhachalam
	West Coast	:	Madakkathara and Vengurle
	Maidan tracts/ others	:	Chintamani

Summary

A total of 112 hybrid nuts were obtained from the crossing programme carried out at Bapatla. A maximum yield of 10.2 Kg tree⁻¹ was obtained for hybrid 4/1. At Bhubaneswar, eight different cross combinations were made and 149 hybrid nuts were obtained. Highest yield was obtained for Bhubaneswar C-1 x VTH 711/4 (0.750 Kg tree⁻¹) five years after planting. During the year 22 different crosses were made and 74 hybrid nuts were obtained at Chintamani. Among the 56 hybrids planted in 1993 highest yield was obtained from V-5 x H 1591 (2.9 Kg tree⁻¹) at Madakkathara and nine hybrids were field planted in 2000 for further evaluation. During the year 14 different cross combinations were undertaken and 1051 hybrid seeds were obtained at Vengurle. H 641 planted in 1991 performed better than other hybrids in terms of yield (5.99 Kg tree⁻¹). At Vridhachalam, the combination M 10/4 x M 26/1 thirteen years after planting produced the highest yield of 4.8 Kg tree⁻¹.

The objectives of this experiment is to utilize 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 synchronized flowering types and high shelling percentage.

BAPATLA

At Bapatla, crossing programme was carried out in Feb - Mar. 1999. A total of 112 hybrids nuts were obtained, out of which more than 100 have been germinated in the nursery and field planted. Only 85 have established in the field. The F1 seedlings of previous years have been multiplied

clonally and planted in the field for further evaluation.

Evaluation of the existing hybrids indicated maximum yield for hybrid 4/1 (10.2 Kg tree⁻¹). However, nut weight was more in hybrid 3/10 (5.8 g). Shelling percentage was maximum in hybrid 3/25 (29.5%) followed by hybrid 4/1 (29%). The data is presented in table 1.28.



Table 1.28: Performance of hybrids at Bapatla.

Hybrid	Parentage	Yield (Kg tree ⁻¹)	Cumulative yield (Kg tree ⁻¹)	Nut weight (g)	Apple weight (g)	Shelling %
2/15	1X40	5.0	151.2	5.2	60.0	28
3/10	56 X 40	3.2	130.7	5.8	32.0	29
3/13	56 X 40	6.1	179.1	5.0	28.0	28
3/25	56 X M 10/4	5.2	142.8	5.2	45.0	29.5
4/1	1 X 40	10.2	158.0	4.8	50.0	29.0

BHUBANESWAR

At Bhubaneswar, eight different cross combinations were made and 149 hybrid nuts were obtained. The maximum success under crossing was observed for H 2/16 x m 44/3 (22.09%) followed by BPP 30/1 x H 2/16 (11.08%). The hybrid seedlings obtained have been planted in the field for further evaluation.

The F1 progeny planted during 1996 started yielding and the data on yield of 3rd harvest for 1995 planting and first harvest in 1996 planted seedlings is presented in Table 1.29. The highest yield was obtained for Bhubaneswar C - 1 x VTH 711/4 i.e. Hybrid B1-21 (0.750 Kg tree⁻¹). The Bhubaneswar 1 x Kankadi hybrid had maximum shelling percentage (32.5).

Table 1.29: Performance of hybrids at Bhubaneswar.

Cross combinations	Hybrid No.	Year of planting	Yield (Kg tree ⁻¹) (harvest)	Cumulative yield (kg tree ⁻¹) (harvest)	Nut Wt. (g)	Shelling %
Bhubaneswar-1 xVTH 711/4	C9	1995	0.450	0.450	8.8	28.8
	C14	1995	0.300	2.800	9.8	30.0
Bhubaneswar C-1xVYH 711/4	A1	1995	0.600	0.600	10.4	30.5
	A3	1995	0.250	0.250	10.4	26.7
	A4	1995	0.250	2.050	9.0	31.5
	A5	1995	0.250	0.250	8.8	30.5
	A6	1995	0.400	4.400	8.3	32.1
Bhubaneswar C-1 x Kankadi	E1	1995	0.200	0.200	9.6	25.0
Bhubaneswar-1 x Kankadi	D3	1995	0.400	0.400	10.0	32.5
	D4	1995	0.500	2.750	8.6	27.2
	D5	1995	0.200	0.200	10.0	25.8
	D6	1995	0.300	1.900	8.9	31.0
	D7	1995	0.150	2.050	10.8	26.7
	D8	1995	0.150	1.800	8.8	28.0
	D9	1995	0.150	0.150	8.7	27.0
Bhubaneswar C-1 x VTH 711/4	B1-3	1996	0.630	0.630	9.0	26.7
	B1-21	1996	0.750	0.750	8.4	23.8
Bhubaneswar C-1 x VTH 711/4	E1-5	1996	0.300	0.300	8.0	31.0
	E1-6	1996	0.350	0.350	8.0	31.0



CHINTAMANI

During the year 22 different crosses were made and 74 nuts were obtained. These seed nuts were planted in the field at close spacing to collect scions for further evaluation. The details of crossing are furnished in Table 1.30.

JHARGRAM

During the year hybridization was taken up using different cross combinations of Jhargram-1, M 44/3, BLA 39-4, Ansur No.1 and D.C. 5. The success rate of cross-pollination was 0.2%. The F1 were planted in the nursery at closer spacing.

MADAKKATHARA

During the year 3 cross combinations were made using BLA 139-1, Sulabha, Madakkathara-1, and V-5. The performance of hybrids planted since 1993 up to 2000 was recorded for height, girth, canopy spread and yield. Among the 56 hybrids planted in 1993 highest yield was obtained from V-5 x H 1591 (2.9 Kg tree⁻¹). Among the 27 hybrids planted in 1994, 85 hybrids planted in 1995, 12 hybrids planted in 1996, 12 hybrids planted in 1998 were evaluated for their growth characteristics. Nine hybrids were planted during 2000 and are establishing well. The data on promising hybrids is presented below in Table 1.31.

Table 1.30 : Details of hybridization carried out at Chintamani.

Sl.No.	Cross Combination	No. of F1 hybrids
1	ARSC 44/1 x ARSC 27/1	8
2	ARSC 44/1 x ARSC 52A/4	5
3	ARSC 35/3 x ARSC 52A/4	3
4	ARSC 5/1 x ARSC 52 A/4	1
5	ARSC 2/6 x ARSC 52 A/4	4
6	ARSC 3/1 x ARSC 27/1	9
7	ARSC 35/3 x ARSC 27/4	7
8	ARSC 39/6 x ARSC 27/4	4
9	ARSC 44/5 x ARSC 27/4	2
10	ARSC 44/5 x ARSC 27/1	1
11	ARSC 44/5 x ARSC 52 A/5	2
12	ARSC 44/1 x ARSC 52 A/5	1
13	ARSC 35/3 x ARSC 27/1	9
14	ARSC 35/3 x ARSC 52 A/5	2
15	ARSC 39/6 x ARSC 27/1	2
16	ARSC 39/6 x ARSC 52 A/4	1
17	ARSC 7/8 x ARSC 27/4	3
18	ARSC 7/8 x ARSC 27/1	1
19	ARSC 35/1 x ARSC 27/4	1
20	ARSC 35/1 x ARSC 52 A/5	2
21	VRI 3 x ARSC 27/1	3
22	ARSC 3/1 X ARSC 27/4	3



Table 1.31: Performance of promising hybrids at Madakkathara.

Year of planting/ Cross combination	Hybrid No.	Height (m)	Girth (cm)	Canopy spread (m)	Yield (Kg tree ⁻¹)
1993					
BLA 139-1 x P 3-2	H-2	6.0	78	7.55	1.15
BLA 39-4 x P 3-2	H-13	5.0	63	6.65	1.10
BLA 39-4 x P 3-2	H-19	6.0	87	6.90	1.50
BLA 39-4 x P 3-2	H-26	5.0	71	7.05	2.60
BLA 39-4 x P 3-2	H-27	5.8	85	7.15	2.20
V-5 x H 1591	H-42	6.1	84	8.80	2.90
1994					
V-5 x H 1591	H-56	5.5	81	6.70	—
V-5 x H 1591	H-83	4.4	53	6.15	—
1995					
Madakkathara-1 x P 3-2	H-102	4.75	59	5.25	—
Anakkayam-1 x P 3-2	H-112	4.5	63	5.65	—
Anakkayam-1 x P 3-2	H-114	5.5	51	5.90	—
Anakkayam-1 x P 3-2	H-118	5.25	49	5.75	—
Madakkathara-1 x P 3-2	H-139	5.25	51	5.40	—
Madakkathara-1 x P 3-2	H-148	4.0	57	5.35	—
Madakkathara-1 x P 3-2	H-149	5.0	52	5.30	—
Madakkathara-1 x P 3-2	H-165	5.0	60	5.30	—
1996					
BLA 139-1 x Vetore-56	H-177	4.5	53	4.40	—
1998					
BLA 139-1 x Kankadi	H-196	1.75	17	2.0	—
BLA 139-1 x Kankadi	H-200	1.75	17	2.05	—
BLA 139-1 x Kankadi	H-201	2.60	23	2.15	—

VENGURLE

During the year 14 different cross combinations were undertaken and 1051 hybrid seeds were obtained out of which seedlings could be obtained for 824 hybrids

only. These will be planted during planting season. The performance of promising hybrids planted in 1991 is presented in Table 1.3. H 641 performed better than other hybrids in terms of yield (5.99 Kg tree⁻¹). Maximum nut weight was recorded for H 675 (18.47g)

**VRIDHACHALAM**

The performance of F1 hybrids was evaluated during the year including eight different combinations. Highest cumulative yield was obtained for M 10/4 x M 26/1 (39.3 kg) for 11 years and highest yield was also

obtained for the same hybrid (4.8 Kg tree⁻¹). The cross combinations M 10/4 x M 45/4, M 26/2 x M 45/4 and M 44/3 x M 45/1 showed moderate TMB resistance. The details of the performance of hybrids is presented below in Table 1.33.

Table 1.32: Performance of promising hybrids at Vengurle.

Hy. No	Cross combination	Nut wt (g)	Yield Kg tree ⁻¹	Apple wt (g)	Shelling %
H 636	V-5 x Kankadi	8.78	4.260	45	28.5
H 640	V-5 x Kankadi	8.00	4.290	60	29.5
H 641	V-5 x Kankadi	8.70	5.990	50	28.5
H 662	V-5 x Kankadi	8.00	5.100	40	29.0
H 675	V-5 x Kankadi (Hy)	18.47	5.800	50	29.0
H 677	V-5 x Kankadi (Hy)	8.32	4.090	62	28.5
H 681	V-5 x Kankadi (Hy)	9.44	4.480	62	28.0
H 689	V-5 x Kankadi (Hy)	8.20	3.560	78	28.0
H 764	V-2 x Kankadi	8.30	5.560	76	28.5
H 784	V-2 x Kankadi	8.00	4.300	86	29.0

Table 1.33: Performance of hybrids planted during 1987 at Vridhachalam.

Cross Combination	Specific characters of parents	Hy. No. per year Kg tree ⁻¹	Mean yield obtained Kg tree ⁻¹	Highest yield 11 years Kg tree ⁻¹	Cum. yield per (g)	Nut Wt. g/tree	Shelling (%) panicle	Apple weight	No. of fruits/
M 10/4 x M 26/1	High yield	H 10	3.57	4.8	39.3	6.60	26.5	59	5
M 10/4 x M 45/4	TMB Resistant	H 11	2.10	3.0	23.2	6.20	27	60	5
M 10/4 x M 75/3	High yield	H 12	2.19	3.3	24.1	6.30	27	61	4
M 26/2x M 26/1	High yield and cluster bearing	H 13	3.07	4.4	33.8	6.30	27.1	63	4
M 26/2 x M 45/4	TMB Resistant	H 14	2.40	3.8	26.5	6.00	27.2	62	5
M 26/2 x M 75/3	High yield	H 15	2.25	3.6	24.8	6.30	26.5	63	5
M 44/3 x M 26/1	High yield	H 16	3.08	3.8	33.9	6.20	26	62	4
M 44/3 x M 45/1	TMB Resistant	H 17	2.62	3.9	28.9	6.00	26.5	60	4



Crop Man.

Agr. 1

NPK Fertiliser experiment

Centres	East Coast	:	Bapatla, Jhargram, and Vridhachalam
	West Coast	:	Madakkathara and Vengurle
	Maidan tracts/ others	:	Chintamani and Jagdalpur

Summary

Highest yield under NPK trial was obtained for 1000g N, 125g P, 125 g K (N2P1K1) (3.50 Kg tree⁻¹) at Bapatla in BPP-5. At Jhargram, the combination 1000g N, 250g P, 250g K (N2P2K2) resulted in maximum yield (5.47 Kg tree⁻¹) in the variety Jhargram-1. At Madakkathara, the application of 500g N, 125g K (N1P0K1) resulted in maximum yield (10.21 Kg tree⁻¹) in BLA 39/4 nine years after planting in interaction trial. At Vengurle, the 1000g N, 250g P, 250g K (N3P3K3) interaction trial with variety V-1 ten years after planting (4.25 Kg tree⁻¹) was significantly superior over other treatments in NPK interaction. Fertilizer application in high-density cashew plantations was initiated in all the centres.

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 results indicated that maximum plant height and girth were recorded for N2P2K2 (54.6 cm, 3.37 cm) followed by N1P1K2 (51.0 cm, 3.15 cm). Highest yield was obtained for N2P1K1 (3.50 Kg tree⁻¹). The yield data for different treatments is presented in Table 2.1.

On-farm trial:

On farm trial was carried out in APFDC Plantations. During the year due to the failure of north-east monsoon in November and December, the effect of fertilizers on yield was vitiated. The data on growth and yield characteristics of the on-farm trial is presented in Table 2.2.



Table 2.1: Effect of N P K fertilizers application on performance of cashew at Bapatla.

Treatment	Height (cm)	Girth (cm)	Yield (Kg tree ⁻¹)
N0P0K0	41.05	2.74	1.25
N0P0K1	35.50	2.19	1.12
N0P0K2	39.35	2.23	1.33
N0P1K0	28.20	1.75	1.06
N0P1K1	37.20	2.55	1.06
N0P1K2	40.90	2.95	1.36
N0P2K0	36.40	2.52	1.06
N0P2K1	37.80	2.43	1.14
N0P2K2	42.70	2.73	1.18
N1P0K0	35.20	2.32	2.77
N1P0K1	48.65	3.08	2.30
N1P0K2	33.90	2.25	2.20
N1P1K0	34.40	2.28	1.40
N1P1K1	37.50	2.27	2.30
N1P1K2	50.95	3.15	1.34
N1P2K0	44.95	2.75	1.53
N1P2K1	42.60	2.80	1.04
N1P2K2	45.60	2.83	1.47
N2P0K0	24.40	1.50	0.87
N2P0K1	32.40	2.08	1.62
N2P0K2	21.45	1.47	2.15
N2P1K0	38.10	2.63	2.37
N2P1K1	48.65	3.08	3.50
N2P1K2	47.10	2.93	1.45
N2P2K0	45.70	2.98	1.62
N2P2K1	41.65	2.88	1.38
N2P2K2	54.60	3.37	2.98

Table 2.2: Effect of higher doses of fertilizer in on farm trial at Bapatla.

Treatments	Girth (cm)	Canopy (m)	No. of panicles m ⁻²	Yield (Kg tree ⁻¹)
T1 - 500-125-125 (NPK)	132.0	12.0	11.0	6.0
T2 - 1000-250-250	138.2	12.8	12.0	6.4
T3 - 1500-375-375	135.2	12.8	11.8	5.8



CHINTAMANI

The various dosages of N, P, and K fertilizers influenced the vegetative growth of cashew. Plant height and girth were significantly influenced by P205, 250g tree⁻¹ (4.90 m, 87.4 cm) and canopy spread did not show any significant increase. However, during the year due to unfavorable weather conditions, the trees failed to

produce any yield. The effect of N, P, and K fertilizers is presented in Table 2.3.

On farm trial:

Two on farm trials initiated during 1998 in cashew plants, which were planted in 1996, are in progress at different farmers fields in Kolar district. The plants are yet to yield and yield is expected in the current harvesting season.

Table 2.3: Effect of NPK and their interaction on plant height at Chintamani

	P0	P1	P2	Mean	K0	K1	K2
N0	4.74	4.90	5.00	4.88	4.81	4.98	4.85
N1	4.60	4.94	4.90	4.81	4.97	4.68	4.78
N2	4/53	4/77	4.80	4.70	4.85	4.55	4.71
Mean	4.62	4.87	4.90	—	4.88	4.74	4.78
K0	4/60	5.06	4.98	—	—	—	—
K1	4.67	4.69	4.85	—	—	—	—
K2	4.59	4.85	4.89	—	—	—	—

CD 5% for P= 0.24

CD 5% for N/P/K = NS

CD 5% for NP/NK /PK= NS

SEm_± for P = 0.084

SEm_± For N/P/K = 0.084

SEm_± For NP/NK/PK = 0.14

JAGDALPUR

On farm trial:

At Jagdalpur, in addition to the normal treatments, one additional treatment of 1500g N, 250g P and 375g K was also

imposed. The plant height, stem girth and canopy spread increased significantly with the increased dose of fertilizer. Among the treatments, T2 was found to be superior over the other treatments. The data on the effect



of NPK fertilizers on growth parameters of cashew seedlings is presented in Table 2.4.

JHARGRAM

At Jhargram the interaction effect shows that the treatment combination

N2P2K2 resulted in maximum yield (5.47 Kg tree⁻¹) followed by N2P2K2 (4.98 Kg tree⁻¹) under NPK fertilizer trial imposed in Jhargram-1 cashew grafts. The details of the NPK interaction on cashew yield are presented in Table 2.5

Table 2.4: Effect of NPK on growth characteristics at Jagdalpur

Treatment	Height (cm)	Girth (cm)	Spread (cm)		No. of primary branches
			N-S	E-W	
T-1 Control	270.5	29.00	252.0	252.75	3.75
T-2 500g N, 125g P, 125g K	293.41	30.00	294.16	290.00	4.58
T-3 1000g N, 250g P, 250g K	329.66	34.33	333.41	351.66	4.41
T-4 1500g N, 250g P, 375g K	314.41	31.25	289.00	313.00	4.50

Table 2.5: Effect of NPK fertilizer and their interaction on yield at Jhargram

Treatment	K0	K1	K2
N0P0	2.06	2.12	2.33
N0P1	1.97	2.89	2.42
N0P2	1.87	2.42	2.88
N1P0	2.27	3.96	4.13
N1P1	2.32	3.92	3.87
N1P2	2.11	3.15	5.47
N2P0	2.45	3.22	3.77
N2P1	2.51	3.15	3.39
N2P2	2.35	4.04	4.98

MADAKKATHARA

At Madakkathara the growth parameters were recorded in this experiment. Maximum height (4.90m) was observed for N2P0K0, maximum girth (57.83 cm) was observed for N2P1K1. However, maximum

canopy spread

NOPOK1. An

maximum

interaction

N, P and K

of cashew

Table 2.6: Effect of N, P & K on growth and yield character

Treatment (m)	Height (cm)	Girth Spread (m)	Canopy spread (m)
NOPOK0	4.18	50.17	4.00
NOPOK1	4.50	56.17	4.00
NOPOK2	3.67	43.33	4.00
NOP1K0	4.07	45.50	4.00
NOP1K1	4.15	52.83	4.00
NOP1K2	3.83	47.00	4.00
NOP2K0	4.27	53.67	4.00
NOP2K1	4.23	58.00	4.00
NOP2K2	4.43	53.00	5.00
N1POK0	3.92	51.67	5.00
N1POK1	4.17	51.67	4.00
N1POK2	4.50	49.50	4.00
N1P1K0	3.85	44.00	4.00
N1P1K1	3.97	49.33	4.00
N1P1K2	4.33	60.00	5.00
N1P2K0	4.15	44.33	4.00
N1P2K1	4.30	51.00	5.00
N1P2K2	4.32	54.50	5.00
N2POK0	4.90	57.83	5.00
N2POK1	4.55	54.17	4.00
N2POK2	4.52	55.67	5.00
N2P1K0	4.30	46.83	5.00
N2P1K1	4.72	60.33	5.00
N2P1K2	3.88	47.83	4.00
N2P2K0	3.98	53.17	4.00
N2P2K1	4.25	51.00	4.00
N2P2K2	4.58	57.50	5.00
SEm±	0.33	7.03	0.50
CD 5%	0.67	NS	NS

**On farm trial**

On farm trial was carried out in farmer's field with Madakkathara-1 grafts. During the year maximum yield (5.20Kg tree⁻¹) was obtained for T-2 (1125g N, 488g P, 1125g K). Plant growth and yield did not increase substantially beyond the T-2 dose. The data recorded on growth and yield parameters is presented below in Table 2.7.

VENGURLE

At Vengurle, among the interactions of N and P the N3P3 (4.125 Kg tree⁻¹) interaction was significantly superior over other treatments. Among N and K interaction, N3K3 (3.680 Kg tree⁻¹) and N3K2 (3.512 Kg tree⁻¹) were on par and significantly superior over other interactions. Among the P and K interaction the P3K3 (3.267 Kg tree⁻¹) was superior over other treatments. The interaction N3P3K3 (4.25 Kg tree⁻¹) followed by N3P3K2 (4.050

Kg tree⁻¹) were superior treatments in NPK interaction. The details of growth and yield in response to NPK fertilizers are presented in Table 2.8.

On farm trial

The on farm trial was conducted at two farmers field with two different varieties namely, V-1 and V-4. The data on yield characteristics of these varieties is presented in Table 2.9.

VRIDHACHALAM

The trial has been laid out with VRI-2 grafts and data on tree height, canopy spread and flowering period indicated the maximum height of 2.20 m in treatment T 21 (N 1000g, P 125g and K 125g). The canopy spread was maximum (3.25 m, 2.93 m) in T 23 (N 500g, P 250g and K 125g). The flowering period was from February to March. The incidence of pest and disease was maximum in this trial. The data is presented in Table 2.10.

Table 2.7: Effect of NPK fertilizer on growth and yield under on-farm trial at Madakkathara.

Treatment	Height (m)	Girth (cm)	Canopy spread (m)	Yield (Kg tree ⁻¹)
T-1 (750g N, 325g P, 750g K)	4.80	75.00	5.75	5.10
T-2 (1125g N, 488g P, 1125g K)	5.50	78.00	6.95	5.20
T-3 (1500g N, 650g P, 1500g K)	5.00	80.00	6.95	5.00

Table 2.8: The yield data in response to NPK fertilizer interaction at Vengurle

	N ₁			Mean	N ₂			Mean	N ₃			Mean	Mean
	P ₁	P ₂	P ₃		P ₁	P ₂	P ₃		P ₁	P ₂	P ₃		
K1	0.490	0.722	1.300	0.84	2.32	4.050	3.225	3.20	2.20	3.25	4.075	3.175	2.404
K2	0.635	1.040	1.595	1.09	2.70	2.975	2.265	2.65	2.835	3.65	4.050	3.51	2.416
K3	0.690	1.575	1.600	1.28	2.15	2.900	3.950	3.00	3.055	3.735	4.25	3.68	2.656
Mean	0.605	1.11	1.50	1.07	2.39	3.31	3.15	2.95	2.70	3.32	4.02	3.45	



Table 2.9: Yield characteristics of cashew under on farm trial at Sindhudurg*

Treatment	Variety	Yield (Kg tree ⁻¹)		Yield (kg/plot)	
		2000	1998-2000	2000	1998-2000
T1-500gN:250gP:250gK	V-4	4.75	11.69	152.00	374.00
	V-1	0.83	2.50	25.00	76.00
T2-1000gN:250gP:250K	V-4	6.06	14.97	194.00	479.00
	V-1	1.00	3.5	30.00	105.00
T3-1500gN:250gP:500gK	V-4	6.39	16.34	204.50	523.00
	V-1	1.30	3.8	39.00	114.00

* V-4 was grown in Kanakawali Taluk and V-1 in Sawantwadi Taluk of Sindhudurg Dist.

Table 2.10: Performance of cashew in response to N, P & K interaction at Vridhachalam.

Treatment	Height (m)	Girth (cm)	Canopy		Flowering period	Pest and disease
			NS	EW		
(T ₁) N ₁ P ₁ K ₁	1.72	28	2.61	3.1	February-March	Incidence of TMB was little high compared to 1999.
(T ₂) N ₁ P ₁ K ₂	1.89	24	2.2	2.4		
(T ₃) N ₁ P ₁ K ₃	1.22	17	2.01	2.2		
(T ₄) N ₁ P ₂ K ₁	2.2	32	2.34	2.25		
(T ₅) N ₁ P ₂ K ₂	1.98	30	2.02	2.29		
(T ₆) N ₁ P ₂ K ₃	1.54	25	2.1	1.98		
(T ₇) N ₁ P ₃ K ₁	1.99	22	3.2	3.48		
(T ₈) N ₁ P ₃ K ₂	1.32	20	1.52	1.89		
(T ₉) N ₁ P ₃ K ₃	1.82	29	2.2	2.62		
(T ₁₀) N ₂ P ₃ K ₁	1.62	24	2.98	3.2		
(T ₁₁) N ₂ P ₁ K ₂	1.72	26	2.32	3.01		
(T ₁₂) N ₂ P ₁ K ₃	1.82	24	2.21	2.82		
(T ₁₃) N ₂ P ₂ K ₃	1.92	26	3.31	3.92		
(T ₁₄) N ₂ P ₂ K ₁	1.42	24	1.87	1.72		
(T ₁₅) N ₂ P ₂ K ₂	1.45	26	1.62	1.54		
(T ₁₆) N ₂ P ₂ K ₃	1.53	24	1.82	2.2		
(T ₁₇) N ₂ P ₃ K ₁	1.22	31	1.21	2.21		
(T ₁₈) N ₂ P ₃ K ₂	1.78	18	2	2.51		
(T ₁₉) N ₂ P ₃ K ₃	1.89	16	2.2	2.52		
(T ₂₀) N ₃ P ₃ K ₁	1.56	22	2.52	2.92		
(T ₂₁) N ₃ P ₁ K ₂	2.2	15	2.92	2.83		
(T ₂₂) N ₃ P ₁ K ₃	1.69	23	2.23	2.92		
(T ₂₃) N ₃ P ₂ K ₃	2.01	28	3.25	2.93		
(T ₂₄) N ₃ P ₂ K ₁	1.41	16	1.52	1.93		
(T ₂₅) N ₃ P ₂ K ₂	2.01	39	3.39	4.41		
(T ₂₆) N ₃ P ₃ K ₂	1.82	29	2.92	2.98		
(T ₂₇) N ₃ P ₃ K ₃	1.88	24	2.25	2.62		



Crop Man.

Agr. 2

Fertiliser application in high density cashew plantations

Centres | East Coast : Bapatla, Bhubaneswar, Jhargram, and Vridhachalam
West Coast : Madakkathara and Vengurle

The objective is to study the response of vegetatively propagated material of cashew to different doses of NPK fertilizers at different spacing for a given regional variety.

Design : Split-plot
Main plot : Density
Subplot : Fertilizer dose
Total area : 2.5 ha

Treatments :

Density : S1 200 plants/ha (10m x 5m)
S2 400 plants/ha (6m x 4m)
S3 500 plants/ha (5m x 4m)

Fertilizer application:

M1	75 Kg N,	25 Kg P ₂ O ₅ ,	25 Kg K ₂ O/ha
M2	150 Kg N,	50 Kg P ₂ O ₅ ,	50 Kg K ₂ O/ha
M3	225 Kg N,	75 Kg P ₂ O ₅ ,	75 Kg K ₂ O/ha

Fertilizers application level:

1st year : 1/5th
2nd year : 2/5th
3rd year : 3/5th
4th year : 4/5th
5th year : Full dose

The experiment is in its initial stages in all the Coordinating Centres. The detailed layout and experimental progress will be reported after establishing the experiment.



Crop Man.

Agr. 4

Expt 1: Spacing trial

Centres	East Coast	: Jhargram
	West Coast	: Vengurle

Summary

Under spacing trial laid in the year 1982, maximum yield per hectare ($752.11 \text{ Kg ha}^{-1}$) was noted in $6 \times 6 \times 6 \text{ m}$ triangular system of planting at Jhargram Centre. Among the trees planted in 1990, the yield in treatment of $5 \times 5 \text{ m}$ square (1573 Kg ha^{-1}), $5 \times 5 \text{ m}$ square with thinning ($1672.00 \text{ Kg ha}^{-1}$) and $5 \times 5 \text{ m}$ square with 75% thinning ($1721.20 \text{ Kg ha}^{-1}$) were on par with each other and were significantly superior over the rest of treatments at Vengurle.

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

Experimental details:

Design	: RBD
Replication	: 3
Plot size	: $25 \text{ m} \times 25 \text{ m}$
Area covered	: 2.25 ha
Variety	: Red Hazari (Jhargram), V-4 (Vengurle)
Year of planting	: July 1982 (Jhargram), July 1990 (Vengurle)

Different spacing trials :

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

**JHARGRAM**

Maximum number of nut per plant was observed in 10x10 m square system (597.67) followed by 10x10x10 m triangular system of planting (578.67). However, maximum yield per block (47.08 kg/block) was noted in 6x6x6 m triangular system of planting followed by 6x6 m square system of planting (43.04 kg/block). Maximum cumulative yield (592.63 kg/block) was recorded in 6x6x6 m triangular planting without thinning followed by 5x5 m square without thinning (562.54 kg/block). The data on yield performance of trees under different spacing is given in Table 2.11.

VENGURLE

At Vengurle, the yield in treatment of 5x5m square (393.40 kg/block), 5x5m square with thinning (418.00 kg/block) and 5x5m square with 75% thinning (430.30 kg/block) were on par with each other and were significantly superior over the rest of treatments. Similarly, the per hectare yields were also high in the same treatments. The growth characters such as height, girth, canopy spread were not significant between the treatments. Considering the yield in the initial years of planting, 5x5 m was good under Vengurle conditions in Vengurla-4 varieties planted under spacing trial experiment. The data on growth and yield performance of cashew trees is presented in Table 2.12.

Table 2.11: Yield performance of cashew trees under different spacing at Jhargram.

Treatment	No. of plants/block	Canopy spread	No. of nuts/tree	Yield			Cumulative yield (13 harvests) Kg/Block
				(Kg/tree)	(kg/block)	(Kg/ha)	
T-1	25	Medium	295.33	1.37	34.25	549.33	562.54
T-2	13	Medium	377.33	1.71	22.23	354.99	305.46
T-3	25	Medium	301.33	1.38	34.50	552.00	477.29
T-4	8	Medium	431.00	2.18	17.44	279.04	308.63
T-5	4	Medium	467.67	2.42	9.68	154.67	139.19
T-6	4	Medium	597.67	2.53	10.12	161.71	104.71
T-7	7	Medium	578.67	2.35	16.45	262.83	178.28
T-8	9	Medium	568.67	2.75	24.75	396.00	149.27
T-9	12	Medium	520.67	2.41	28.92	434.40	369.07
T-10	16	Medium	563.67	2.69	43.04	689.49	565.03
T-11	22	Medium	486.33	2.14	47.08	752.11	592.63
T-12	13	Medium	358.67	1.62	21.06	336.96	315.68
SEm±			4.774	0.023		7.315	
CD 5%			9.902	0.047		15.172	



Crop Man.

Agr. 4

Expt. 2: High density planting trial

Centres | West Coast : Vengurle
| Maidan tracts/ others : Chintamani

CHINTAMANI

During 1997 high density planting was established using Chintamani-1 grafts at a spacing of 4 x 4 m. The observation was recorded at a random from 25 plots. The growth parameters are presented in Table 2.13.

VENGURLE

High density planting was taken up with the variety of Vengurla-7 at a spacing of 4 x 4 m during August 1998 in an area of 0.2 ha. During the period under report, the trees have started yielding and 6.2 kg of nuts could be obtained per plot. The data recorded on growth parameters is presented in Table 2.14.

Table 2.13. Growth characteristics of Chintamani-1 grafts at Chintamani.

Parameters	Plant height (m)	Girth (cm)	Canopy spread (m)	
			EW	NS
Maximum	3.4	31.0	3.20	3.60
Minimum	1.45	10.0	1.80	1.90
Mean	1.87	13.33	2.50	2.75

Table 2.14: Growth characteristics of high density planting at Vengurle.

Treatment	Height (cm)	Girth (cm)	No. of branches
1	1.92	25.25	46.80
2	2.05	26.55	51.00
3	2.15	29.77	51.44
4	2.24	27.05	51.00
5	2.04	31.00	55.00
6	2.08	31.40	51.90
7	2.26	29.00	56.00
8	2.14	26.5	55.22
9	2.22	27.6	53.9
10	2.03	23.7	44.5
11	1.81	23.77	34.00
12	2.00	24.53	36.25

The above data are averages of 10 grafts in each row.



Crop Man.

Agr. 6

Cashew based cropping system

Centres | East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam
 | West Coast : Madakkathara and Vengurle

Summary

Intercropping trial indicated that during kharif season cluster bean was found to be most economical and during Rabi black gram was found to be remunerative at Bapatla. At Bhubaneswar, Cashew intercropped with turmeric fetched highest returns. Growing of tuber crops in cashew plantations was not found to be economical during the year under Madakkathara conditions. At Vridhachalam, it was found that the groundnut is highly profitable as an intercrop in cashew plantation.

The objectives are to:

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

Experimental details:

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

Sub-plot:

F0 - 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

During the year both kharif and Rabi intercropping experiments were conducted. During kharif season cluster bean was found most economical and during Rabi black gram was found remunerative. The data on yield and returns of intercrops in cashew is given

below in Table 2.15.

BHUBANESWAR

The cashew plants were spaced at 10x10 m as a main crop and the other intercrops were grown at different



spacing. The cashew intercropped with turmeric fetched highest returns of Rs. 37,140/- followed by cashew + cowpea (Rs. 33,320/-). The details of yield obtained for the main crop as well as for intercrop is presented below in Table 2.16.

While taking the economy of cashew growing, turmeric was found most economic crop under cashew plantation. Growing amorphophallos as well as cowpea were also found economical.

Table 2.15: Yield and net returns from intercrops in cashew at Bapatla

Intercrop	Plant height (cm)	Yield		Rate Rs./Kg	Total income	Expenditure	Net income
		G/2m ²	Kg ha-1				
KHARIF							
Bhendi	55	520	2600	4.0	10400	8700	1700
Cluster bean	64	1000	5000	2.5	12500	9000	3500
Blackgram	37	105	525	18.0	9450	7600	1850
Green gram	32	82	410	15.0	6150	6500	-
RABI							
Greemgram	30	74	370	15.0	5550	6500	-
Black gram	35	122	610	18.0	10980	7600	3380
Mustard	60	50	250	20.0	5000	6500	-
Red gram	56	102	510	15.0	7650	6500	1150

Table 2.16: Performance of cashew and its intercrop at Bhubaneswar.

Crop	Yield Qtl/ha		Price (Rs./Qtl.)		Total returns		
	Cashew	Intercrop	Cashew	Intercrop	Cashew	Intercrop	Total
Cashew alone	7.50	-	3000	-	22500	-	22500
Cashew+Cowpea	8.40	20.30	3000	400	25200	8120	33320
Cashew+Pumpkin	6.50	46.00	3000	100	19500	4600	24180
Cashew+Amorphophallus	5.40	36.00	3000	450	16200	16200	32400
Cashew+Turmeric	6.50	42.00	3000	420	9500	17640	37140
Cashew+Greengram	6.70	1.20	3000	1200	28100	1440	29540



JHARGRAM

During the period under report, intercropping was done with Jowar, cowpea, okra and greengram along with cashew at the centre. However, the centre could not report any data from this experiment.

MADAKKATHARA

During the XIV Biennial Workshop it was suggested to remove the medicinal plants and replant it with pineapple and tuber crops. The planting of tuber crops was taken up during the period under report. The performance of main crop was good whereas the turmeric as intercrop did not produce any tubers and the yield obtained was negligible. The tuber yield in coleus was only 19.5kg/plot (plot size 30.25 m²). Therefore, growing these tuber crops in cashew plantation under Madakkathara condition was not found to be remunerative during the year.

VENGURLE

During the period under report, ridge gourd, bitter gourd, cucumber, okra, and cowpea were grown as intercrops with cashew. The adverse weather conditions severely affected these vegetable crops and no yield could be obtained.

VRIDHACHALAM

The experiment was conducted in high-density cashew plantation at 4 x 4 m spacing with four crops such as blackgram, cowpea, sesame and groundnut. The maximum tree girth (38.2 cm) and canopy spread (3.68, 3.42 m) was obtained in the plot grown with groundnut as intercrop. The soil moisture was high when the intercrop was groundnut (19%). From the experiment, it is found that groundnut is highly profitable as an intercrop in cashew plantation. The details of the performance of intercrops under cashew plantations are given in Table 2.17.

Table 2.17: Performance of cashew and its intercrop at Vridhachalam.

Treatment	Height (cm) main	Girth (cm)	Canopy (cm)		Moisture content (%)	Revenue Rs.	Yield (kg) Main	Intercrop Yield kg
			E-W	N-S				
T1 Cashew + Blackgram	404	38.2	3.62	3.22	17	3200	-	330
T2 Cashew + Cowpea	398	36.8	3.62	3.59	18	2400	-	445
T3 Cashew + Sesame	415	35.7	3.35	3.42	15	2800	-	130
T4 Cashew + Groundnut	340	36.2	3.68	3.42	19	3920	-	720
Cashew as sole crop	352	34.2	3.42	3.44	17	-	-	-



Crop Man.

Agr. 7

Drip irrigation trial

Centres	East Coast	:	Vridhachalam
	West Coast	:	Vengurle
	Maidan tracts/ others	:	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. Experimental details:

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 : Vengurle-7
		Vridhachalam : VRI-3

CHINTAMANI

Planting of 240 grafts of Chintamani-1 has been done during September 1997. The establishment of plants is quite satisfactory at Chintamani Centre. Drip irrigation system will be established during the year 2001-2002.

VENGURLE

At Vengurle, this trial has been laid out at Agricultural Research Station, Mulde, Kudal, and Sindhudurg District. Soft wood

grafts of Vengurle-7 were planted at a spacing of 5 m x 5 m for the purpose of implementing the trial. The drip irrigation treatments have been imposed from January 2000 and data will be reported in the next reporting year.

VRIDHACHALAM

Planting for this experiment will be carried out soon after establishment of drip irrigation facilities at Vridhachalam in 2001-2002.



Crop Prot.

Chemical control of pest complex in cashew

Ent. 1

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

Centres	East Coast	:	Jhargram, and Vridhachalam
	West Coast	:	Madakkathara, and Vengurle
	Maidan tracts/ others	:	Chintamani and Jagdalpur

Summary

At Chintamani, least incidence of TMB was recorded in trees received spray at flushing, flowering and fruiting stages. The population of natural enemies was highest in untreated control (T-10) during all the stages. However, in experiment initiated during 1995-96 on BLA 139-1 the yield was highest for trees sprayed with monocrotophos at flushing, endosulfan at flowering and carbaryl at fruiting (T-5, 6.59 Kg tree⁻¹). At Jagdalpur also, the maximum yield was recorded for the trees treated with treatment T-5 (6.0 Kg tree⁻¹). The treatment T-5 was found to be more effective than the other treatments after third spray, but however, the results were not significant at Vengurle. Standard spray (T5) was found to be most effective treatment at Vridhachalam.

The objective of the project is 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 alternate chemicals in comparison with standard insecticidal spray schedule against pests of cashew.

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

**CHINTAMANI**

The percent incidence of TMB and the number of natural enemies at flowering, fruiting and harvesting stages in different treatments is presented in Table 3.1. In trees, which received spray at flushing, flowering and fruiting stages, least incidence of TMB was recorded. However, the population of natural enemies was highest in untreated control (T-10) during all the stages. The yield was highest in T-5 (6.59 kg/tree), which was significantly higher than all other treatments.

JAGDALPUR

At Jagdalpur, among all the treatments imposed, maximum yield was recorded for the trees treated with treatment T-5 (6.0 kg/tree) and provided significantly superior results over the other treatments. The

incidence of TMB and other pests of cashew are presented in Table 3.2.

JHARGRAM

Due to the low population (0.4 - 1.1%) of TMB at Jhargram, the experiment of control on major pest - TMB was not carried out during the year.

MADAKKATHARA

The most effective treatment was spraying endosulfan (0.05%) at flowering and carbaryl (0.1%) at fruiting stage (T7) followed by spraying endosulfan (0.05%) followed by neem oil 2% (T-8). The trees treated with T-7, highest yield was obtained (13.55 kg/tree) followed by T-8 (11.25 kg/tree). The details of pest incidence are presented in Table 3.3.

Table 3.1: Incidence of tea mosquito bug and natural enemies at Chintamani.

Treatment	TMB (%)			Leaf miner (%)	Inflorescence thrips		Natural enemies (No.)			Yield (kg/tree)
	30 days after Ist spray	30 days after II spray	30 days after III spray	30 days after III spray	30 days after II spray	30 days after III spray	30 days after spray	30 days after II spray	30 days after III spray	
T-1	1.83	13.94	4.28	2.73	11.12	15.25	1.28	2.02	3.42	2.39
T-2	16.22	2.08	4.46	23.92	6.66	14.42	3.26	1.32	2.02	4.90
T-3	16.26	13.85	1.11	24.12	11.38	4.88	3.02	4.52	2.62	2.70
T-4	1.93	2.21	4.30	2.37	6.01	14.70	1.02	0.68	1.96	5.20
T-5	2.00	2.14	0.95	2.53	5.82	4.51	0.96	0.75	0.42	6.59
T-6	2.01	14.11	0.93	2.53	10.80	4.62	1.12	1.48	0.68	2.52
T-7	16.82	2.34	1.26	24.44	5.42	4.34	2.96	1.30	0.62	5.58
T-8	15.81	1.73	1.46	24.67	5.53	4.32	3.11	1.26	0.52	5.89
T-9	16.45	1.98	1.25	25.35	5.62	4.43	2.64	1.38	0.58	5.69
T-10	16.60	14.10	4.54	26.56	12.63	15.05	3.21	4.60	4.80	2.63
SEm ±	11.09	0.76	0.51	1.50	0.98	0.76				0.24
CD 5%	3.28	2.28	1.54	3.50	2.93	2.28				0.72



Table 3.2: Incidence of TMB and other pests of cashew at Jagdalpur.

Treatment	Flower damage (%)	Leaf damage (%)			Yield (kg/tree)	
	TMB	TMB	Leaf miner	Caterpillar		Leaf roller
T-1	48.0	4.2	2.2	6.0	3.0	2.2
T-2	8.5	6.2	3.0	3.0	4.0	2.0
T-3	55.0	7.5	3.5	5.0	4.2	1.5
T-4	9.0	1.8	1.2	4.2	3.5	2.5
T-5	8.2	1.5	1.0	1.4	1.3	6.0
T-6	52.5	9.0	1.5	3.8	2.6	1.8
T-7	25.0	1.8	1.5	3.5	4.5	2.2
T-8	12.5	0.9	2.3	10.0	3.5	1.6
T-9	45.0	2.7	1.75	4.5	6.0	1.5
T-10	57.0	7.2	10.5	25.0	12.0	0.6

Table 3.3: Incidence of tea mosquito bug (TMB) at Madakkathara

Treatment	Pre-treatment count		After II spray		After III spray		Yield (kg/tree)
	Shoot (%)	Panicle (%)	Panicle (%)	Nut (%)	Panicle (%)	Nut (%)	
T-1	Skipped the spray						
T-2	10.30	13.15	8.82	-	9.45	7.00	4.50
T-3	7.60	9.80	7.75	-	8.70	8.25	5.60
T-4	7.44	10.62	8.40	1.45	8.55	7.45	5.00
T-5	11.00	9.33	6.50	-	6.25	4.50	9.25
T-6	8.60	10.25	8.00	-	10.50	7.33	5.00
T-7	7.90	11.23	4.55	-	7.50	3.87	13.55
T-8	8.70	12.56	5.33	2.39	6.22	5.00	11.25
T-9	7.33	11.33	6.00	-	9.66	6.35	8.33
T-10	10.79	8.63	11.55	-	9.45	7.22	6.50

VENGURLE

The pesticide treatments in first spray was not significantly effective, whereas, observation recorded 30 days after the II

spray indicated that the incidence of pest was significantly low in spraying endosulfan 0.05% at flowering (T-2) followed by spraying endosulfan (0.05%) at flowering and carbaryl



(0.1%) at fruiting stage (T7) and T-5 (standard spray) as compared to the control. The treatment T-5 was found to be more effective than the other treatments after III spray, but however, the results were not significant. The data on various pesticide

treatments is presented in Table 3.4.

VRIDHACHALAM

At Vridhachalam, the most effective treatment was the standard spray (T-5) followed by T-7 (Table 3.5).

Table 3.4: Incidence of tea mosquito bug (TMB) at Vengurle

Treatment	Percent damage after 30 days					
	I Spray		II Spray		III Spray	
	Shoot	Panicle	Shoot	Panicle	Shoot	Panicle
T-1	0.41	2.09	15.61	22.38	30.11	33.21
T-2	1.40	5.58	7.32	10.34	22.71	29.59
T-3	0.00	0.00	3.47	15.71	23.83	29.05
T-4	7.93	7.61	5.99	13.84	28.76	32.39
T-5	4.29	5.54	4.61	11.95	16.47	23.78
T-6	2.54	3.03	8.00	16.21	19.59	28.38
T-7	0.00	0.00	4.20	10.83	27.29	26.37
T-8	0.28	2.39	7.01	15.26	34.15	35.54
T-9	0.56	2.49	5.94	13.47	24.54	29.60
T-10	0.79	4.03	18.32	25.21	28.28	36.39
SEm±	2.192		2.786		2.780	
CD 5%	NS		8.274		NS	

Table 3.5: Incidence of tea mosquito bug (TMB) at Vridhachalam

Treatment	Pre treatment count	Post treatment count		
		I spray	II spray	III spray
T1	3.3	2.3	1.8	1.0
T2	2.9	2.2	1.6	1.3
T3	2.8	1.8	1.2	0.9
T4	3.2	2.4	2.0	1.1
T5	2.7	1.7	1.0	0.3
T6	2.6	1.9	1.5	0.6
T7	2.9	1.5	1.4	0.5
T8	3.1	2.3	1.6	0.8
T9	2.7	2.3	1.7	0.7
T10	3.0	3.6	3.2	3.9



Crop Prot.

Chemical control of pest complex in cashew

Ent. 1

Expt. 2: Control of minor pests

Centres	East Coast	: Bhubaneswar, Jhargram, and Vridhachalam
	West Coast	: Madakkathara, and Vengurle
	Maidan tracts/ others	: Chintamani and Jagdalpur

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

BHUBANESWAR

The treatments T-1, T-4, T-5 and T-6 were good in controlling shoot tip caterpillar. The population of inflorescence thrips was not significantly influenced by Ist spray (0.75 to 2.21) but the population drastically influenced after the II spray and after the III spray the population was significantly lower (0.42%). The inflorescence thrips and leaf folders were susceptible for T-5 treatment. The natural enemies observed in the experiment were spiders, predator spiders (*Angeope* sp.), mirid bugs, lady bird beetles and black ants. Maximum population of spiders was observed in T-10, whereas, the effect of different treatments was non

significant at 30 days after the I, II and III sprays on spider population. The data on incidence of various pests of cashew is given in Table 3.6.

CHINTAMANI

The incidence of leaf miner was least in trees receiving spray at flushing stage. Similarly, inflorescence thrips population was lowest in trees receiving sprays at flowering and fruit setting stages. The data on incidence of different minor pests is included in Table 3.1.

JAGDALPUR

The incidence of minor pests was low in standard spray i.e. T-5. Maximum yield



6.0 kg/tree was obtained, which was significantly superior over the other combinations. The data on minor pests of cashew is presented above in Table 3.2.

JHARGRAM

The incidence of leaf miner, shoot and blossom webber and shoot tip caterpillar was very low in T4 and T5 treatments. The average incidence of leaf miner was 1.47,

1.49 and 1.51 respectively in T5, T4 and T1 during the first round of treatment as compared to 4.23 in control. It was observed that insect control is effective when the plants were sprayed two to three rounds of treatments T4 and T5. Maximum nut yield was 2.280 in T4 and 2.270 kg/tree in T5 as compared to 1.380 kg/tree in control. The details of incidence of different pests of cashew are presented in Table 3.7.

Table 3.6: Occurrence of minor pests of cashew at Bhubaneswar.

Treatments	% Infestation tip borer		% Infestation by leaf folder		Mean inflorescence thrips population				Mean score of thrips	Yield kg/tree
	Pre-treatment count	30 days after 1 st spray	30 days after 1 st spray	30 days after 1 st		30 days 2 nd spray		30 days after 3 rd spray		
				YT	BT	YT	BT			
T1	6.03 (2.55)	0.63 (1.06)	0.85 (1.12)	1.42 (1.37)	- (1.04)	0.59 (1.34)	1.30 (0.99)	0.50	0.35	5.830
T2	7.19 (2.77)	5.38 (2.42)	2.78 (1.81)	1.59 (1.44)	0.21 -	1.25 (0.84)	0.54 (1.30)	0.14 (1.02)	4.380	
T3	8.45 (2.99)	3.44 (1.84)	3.07 (1.89)	1/92 (1.55)	- -	0.67 (1.08)	1.34 (1.05)	0.17 (0.82)	0.30	5.580
T4	6.53 (2.64)	1.84 (1.43)	1.22 (1.24)	0.75 (1.11)	- -	0.46 (0.98)	1.29 (1.33)	0.67 (1.08)	0.16	6.370
T5	7.91 (2.89)	1.31 (1.34)	0.66 (1.05)	0.96 (1.21)	- -	0.17 (0.81)	0.42 (0.96)	0.34 (0.89)	0.08	8.530
T6	8.49 (3.00)	1.29 (1.33)	1.42 (1.38)	1.29 (1.34)	- -	0.71 (1.10)	1.25 (1.32)	0.34 (0.91)	0.35	5.430
T7	9.83 (3.21)	4.62 (2.25)	4.73 (2.28)	2.21 (1.64)	- -	0.33 (0.91)	1.50 (1.40)	0.54 (1.02)	0.16	4.200
T8	7.99 (2.96)	4.86 (2.31)	3.51 (2.00)	1.87 (1.53)	- -	0.34 (0.91)	1.46 (1.40)	0.38 (0.93)	0.10	5.430
T9	9.50 (3.15)	5.51 (2.40)	3.62 (2.03)	1.84 (1.53)	- -	0.30 (0.89)	1.17 (1.27)	0.50 (0.99)	0.16	4.530
T10	8.61 (3.01)	8.89 (3.07)	6.17 (2.57)	2.59 (1.76)	- -	2.34 (1.68)	2.84 (1.82)	2.13 (1.62)	0.47	2.230
SEm±	0.2	0.245	0.18	0.08	-	0.09	0.14	0.15		
CD 5%	0.42	0.51	0.38	0.17	-	0.20	0.29	0.32		



Table 3.7. Incidence of minor pests of cashew at Jhargram

Treatments	Pre-treatment count			After 1 st spray			After 2 nd spray			Yield kg/tree
	Leaf miner	S&B Webber	Shoot tip caterpillar	Leaf miner	S&B Webber	Shoot caterpillar	Leaf miner	S&B Webber	Shoot caterpillar	
T1	1.2 (1.30)	0.6 (1.05)	1.0 (1.22)	1.52 (1.42)	1.32 (1.35)	1.76 (1.50)	3.53 (2.00)	4.36 (2.20)	3.50 (2.00)	2.550
T2	1.24 (1.32)	0.70 (1.10)	0.80 (1.14)	2.59 (1.76)	3.40 (1.97)	1.81 (1.52)	5.63 (2.48)	4.80 (2.30)	3.96 (2.11)	2.325
T3	1.10 (1.26)	0.30 (0.89)	1.20 (1.30)	3.60 (2.02)	3.50 (2.00)	2.08 (1.61)	6.33 (2.61)	5.33 (2.41)	4.80 (2.30)	2.190
T4	1.20 (1.30)	0.30 (0.89)	1.00 (1.22)	1.49 (1.41)	1.28 (1.33)	1.10 (1.26)	2.26 (1.66)	2.16 (1.63)	1.62 (1.46)	2.980
T5	1.00 (1.22)	0.60 (1.05)	0.90 (1.18)	1.47 (1.40)	1.30 (1.34)	1.06 (1.25)	2.27 (1.66)	2.18 (1.64)	1.60 (1.45)	2.970
T6	0.80 (1.14)	0.40 (0.95)	0.80 (1.14)	2.06 (1.60)	1.38 (1.37)	1.56 (1.60)	3.80 (2.07)	2.23 (1.65)	1.83 (1.53)	2.910
T7	1.42 (1.39)	0.60 (1.05)	0.60 (1.05)	3.46 (1.99)	4.30 (2.19)	1.83 (1.53)	4.98 (2.34)	5.13 (2.37)	2.46 (1.72)	2.785
T8	1.39 (1.74)	0.80 (1.14)	1.00 (1.22)	3.56 (2.01)	4.60 (2.26)	1.20 (1.30)	5.23 (2.39)	5.28 (2.46)	3.38 (1.97)	2.660
T9	1.00 (1.22)	0.60 (1.05)	0.80 (1.14)	3.76 (2.06)	4.16 (2.16)	3.55 (2.01)	5.39 (2.43)	4.95 (2.33)	4.43 (2.20)	2.400
T10	0.60 (1.05)	0.60 (1.05)	1.00 (1.22)	4.23 (2.17)	4.93 (2.33)	3.96 (2.11)	7.36 (2.80)	9.00 (3.08)	8.88 (3.06)	1.380
CD 5%	0.09	0.08	0.09	0.12	0.10	0.09	0.12	0.10	0.12	0.11

*S&B = Shoot and Blossom

MADAKKATHARA

The incidence of minor pests like leaf miner, leaf roller, blossom webber and thrips were also low in T-7 followed by T-8. Population of natural enemies like ants, spiders and chrysopa were high in T-8 than in T-5. The Details of observation done on minor pests of cashew is presented in Table 3.8 and natural enemies in Table 3.9.

VENGURLE

Treatments T5, T3, T6 and T7 were found to be equally effective in managing inflorescence thrips. Treatment T5 was effective at peanut, pebble nut as well as mature nut stage. In peanut and pebble nut stage, T7, T3 and T6 were also at par with T5. The details of incidence of minor pest of cashew are presented in Table 3.10.



VRIDHACHALAM

Observations were made for the incidence of various minor pests such as pink leaf folder (*Anigraea albomaculata* Hamp),

green leaf folder (*Sylepta auaratiacalis* Fish), nut borer (*Thylocopula panerosema*) and other minor pests population and were found to be minimum.

Table 3.8. Incidence of minor pests of Cashew at Madakkathara

Treat ment	Pre-treatment count		After II spray				After III Spray	
	Leaf miner		Leaf roller	Blossom weber	Thrips	Mean score	Thrips	Mean score
	Shoot (%)	Leaves (%)						
T2	0.22	0.17	-	-	-	-	-	-
T3	0.16	0.33	-	1.80	-	-	1.30	0.20
T4	0.20	0.45	-	0.65	-	-	-	-
T5	0.18	0.18	-	-	-	-	-	-
T6	0.05	0.23	0.45	2.30	0.28	0.13	1.80	0.26
T7	0.19	0.19	-	0.65	-	-	1.69	0.40
T8	0.23	0.20	-	0.70	-	-	-	-
T9	0.17	0.21	1.60	1.00	0.33	0.18	-	-
T10	0.18	0.24	-	2.75	-	-	-	-

Table 3.9: Occurrence of natural enemies of cashew pests at Madakkathara.

Treatment	Pre-treatment count		After II spray				After III spray			
	Ants	Spiders	Ants	Spiders	Mirid bugs	Chrysopa	Ants	Spiders	Mirid bugs	Chrysopa
T2	3.50	1.05	2.40	1.60	-	0.43	3.40	-	-	-
T3	2.60	1.22	1.85	1.00	-	-	2.80	-	-	0.22
T4	2.80	1.00	2.00	-	1.40	1.11	1.30	2.40	-	0.16
T5	2.60	1.60	1.05	1.11	-	1.35	1.00	1.80	-	-
T6	3.70	2.30	1.10	-	0.05	1.40	1.11	-	-	0.18
T7	3.33	1.40	2.25	1.80	0.10	1.10	2.90	1.80	-	0.25
T8	2.50	2.40	1.00	1.10	-	1.30	2.65	1.60	0.85	0.21
T9	3.45	2.40	1.40	-	-1.00	1.60	1.33	-	-	-
T10	4.60	2.90	2.90	2.30	0.67	1.80	2.77	1.75	0.93	0.18



Table 3.10 : Incidence of inflorescence thrips on cashew at Vengurle

Treatment	Average nut surface damaged at		
	Pea nuts	Pebble nuts	Matured nuts
T1	19.66 (26.31)	23.98 (29.25)	24.39 (29.56)
T2	19.17 (26.02)	25.48 (30.28)	27.74 (31.77)
T3	16.71 (24.11)	19.21 (25.99)	19.58 (26.25)
T4	19.66 (26.31)	27.63 (31.7)	27.15 (31.40)
T5	14.45 (22.31)	17.61 (24.81)	18.86 (25.76)
T6	16.57 (24.02)	20.84 (26.91)	21.84 (27.80)
T7	15.22 (22.94)	19.49 (26.24)	21.87 (27.85)
T8	20.70 (27.03)	21.83 (27.83)	27.27 (31.92)
T9	21.35 (25.84)	24.15 (29.68)	26.86 (31.21)
T10	24.43 (29.62)	33.58 (35.35)	34.9 (36.13)
S.E.m±	0.745	1.477	0.984
C.D. at 5%	2.211	4.387	2.923

**Crop Prot.****Ent. 1****Chemical control of pest complex in cashew****Expt. 3: Evaluation of new chemicals for control of TMB and other pests**

Centres	East Coast	:	Bhubaneswar and Vridhachalam
	West Coast	:	Madakkathara, and Vengurle
	Maidan tracts/ others	:	Chintamani and Jagdalpur

Summary

The standard spray was the most effective treatment compared to other treatments at Bhubaneswar. At Chintamani, highest yield of 6.25 Kg tree⁻¹ was recorded in treatment with profenophos. At Jagdalpur ethofenprox 0.015% was found to be better than all other treatments. Spraying monocrotophos at flushing (T1) was the most effective control for pests of cashew at Jhargram. Highest yield was reported from Madakkathara in treatment T5 (8.80 Kg tree⁻¹). At Vengurle, spraying with chlorpyriphos (0.05%) was found to be effective in controlling TMB. Standard spray (T1) was found to be most effective at Vridhachalam.

Treatments:

- T 1 : Recommended sprays for the region
- T 2 : Chlorpyriphos 0.05%
- T 3 : Triazophos 0.1%
- T 4 : Ethofenprox 0.015%
- T 5 : Profenophos 0.05%
- T 6 : Control

BHUBANESWAR

Under the trial, three alternative chemicals were tested namely, T2 - chlorpyriphos (0.05%), T3 - Triazophos (0.1%) and T5 - Profenophos (0.05%). The incidence of Tea Mosquito Bug (TMB) was not noticed during the period. The other two minor pests recorded were inflorescence thrips and shoot tip caterpillars. The

standard spray was the most effective treatment compared to other treatments. All the other three chemicals were found equally effective in controlling shoot tip caterpillar. The details of incidence of various pests in response to the treatment with new chemicals are presented in Table 3.11.

**CHINTAMANI**

The results indicated that new chemicals tried were comparable to the standard chemicals in control of TMB, leaf and blossom webber and inflorescence thrips. Highest yield of 6.25 kg/tree was recorded in T4. The details of the incidence of pests of cashew are presented in Table 3.12.

JAGDALPUR

Among the new chemicals tested, ethofenprox 0.015% was found to be better than all other treatments. Average nut yield was 4.80 kg/tree in this treatment. The details of incidence of pests of cashew in response to the new chemicals tried are presented in Table 3.13.

Table 3.11: Incidence of pests recorded after spraying with new chemicals at Bhubaneswar.

Treatment	Shoot tip caterpillar (%)		Yellow Inflorescence thrips		Black Inflorescence thrips			Mean score value of thrip infestation	Yield (kg/tree)
	One DBS	30 DAS	30 days after 1 st spray	30 days after II spray	30 Days after 1 st spray	30 days after II spray	30 days after III spray		
T1	5.43 (2.43)	0.95 (1.21)	1.72 (1.48)	0.75 (1.09)	0.69 (1.07)	1.10 (1.25)	0.12 (0.81)	0.11	7.500
T2	5.31 (2.41)	1.63 (1.46)	2.17 (1.62)	0.98 (1.21)	1.00 (1.22)	1.51 (1.40)	0.47 (0.99)	0.29	4.800
T3	5.68 (2.48)	1.75 (1.49)	1.78 (1.48)	1.02 (1.21)	0.75 (1.10)	1.03 (1.18)	0.41 (0.94)	0.31	5.800
T4	-	-	-	-	-	-	-	-	-
T5	5.27 (2.40)	1.74 (1.48)	1.85 (1.51)	1.38 (1.37)	1.12 (1.30)	1.72 (1.47)	0.82 (1.14)	0.14	3.270
T6	6.40 (2.59)	3.77 (2.06)	2.97 (1.86)	3.46 (1.98)	2.66 (1.77)	3.57 (2.02)	1.72 (1.49)	0.49	2.310
SEm±	0.20	0.11	0.17	0.17	0.12	0.21	0.09	-	-
CD 5%	NS	0.24	NS	0.37	0.27	0.45	0.21	-	-

DBS = Days before spray; DAS = Days after spray


Table 3.12. Incidence of pests recorded after spraying with new chemicals at Chintamani.

Treatment	TMB (%)			Leaf	Inflorescence thrips		Yield (kg/tree)
	30 DAS I spray	30 DAS II spray	30 DAS III spray	30 DAS II spray	30 DAS II spray	30 DAS III spray	
T1	2.29	2.19	0.88	2.45	5.05	5.07	6.19
T2	2.60	2.38	0.82	2.38	4.96	4.67	6.03
T3	2.50	2.24	0.83	2.45	5.09	4.78	6.15
T4	-	-	-	-	-	-	-
T5	2.63	2.17	0.85	2.29	5.12	4.76	6.25
T6	17.07	14.62	4.64	25.65	11.33	14.85	2.85
SEm±	0.35	0.29	0.17	0.68	0.26	0.42	0.33
CD 5%	1.04	0.88	0.51	2.04	0.77	1.26	0.99

Table 3.13. Incidence of pests recorded after spraying with new chemicals at Jagdalpur

Treat ments	TMB		Leaf	Caterpillar	Leaf	Yield (Kg/tree)
	Inflorescence	Leaves	miner (%)	(%)	roller (%)	
T1	10.2	1.3	3.2	4.0	6.2	2.8
T2	5.0	3.9	0.9	2.8	6.2	2.7
T3	6.0	1.2	2.1	7.2	4.0	3.9
T4	2.5	1.2	1.0	4.0	3.5	4.8
T5	8.5	2.2	2.9	7.0	2.8	3.8
T6	42.8	7.5	6.0	10.0	8.5	3.0

JHARGRAM

Standard treatment T1 was the most effective one in controlling pests of cashew at Jhargram. Among the new insecticides tested Profenophos (0.05%) was effective against inflorescence thrips. A good control over shoot tip caterpillar could be obtained in T1 (2.16) and T5 (2.48) respectively. The details of incidence of TMB and other pests of cashew at Jhargram are presented in Table 3.14.

MADAKKATHARA

When compared to the standard spray, T2, T3 and T5 were found equally good. Highest yield was recorded in T5 (8.80 kg/tree) followed by T6 (6.70 kg/tree). Minor pests like leaf miner, leaf roller and blossom webber were also found to be low in T1, T3 and T5 treatment. The details of incidence of pest of cashew in response to the new chemicals are presented in Table 3.15.



VENGURLE

Spraying with Chlorpyrifos was also effective in controlling TMB and comparable with the standard spray (T1). These chemicals were found equally effective for control of flower thrips also. The details of

incidence of TMB in response to new chemicals are presented in Table 3.16.

VRIDHACHALAM

The standard spray (T1) was the most effective treatment. Data is reported in Table 3.17.

Table 3.14. Incidence of pests recorded after spraying with new chemicals at Jhargram.

Treat ments	Pre-treatment count		After I Spray		After II Spray		After III Spray		Yield kg/tree
	Shoot tip caterpi llar	Inflor escence thrips	Shoot tip caterpi llar	Inflor escence thrips	Shoot tip caterpi llar	Inflor escence thrips	Shoot tip caterpi llar	Inflor escence thrips	
T-1	2.00 (1.58)	0.08 (1.14)	2.16 (1.63)	1.20 (1.30)	2.65 (1.77)	1.80 (1.52)	3.00 (1.87)	2.25 (1.66)	3.000
T-2	2.20 (1.64)	0.09 (1.18)	3.58 (2.02)	1.82 (1.52)	4.36 (2.20)	4.50 (2.24)	6.60 (2.66)	5.85 (2.52)	2.250
T-3	2.08 (1.61)	0.06 (1.05)	3.96 (2.11)	1.86 (1.57)	4.70 (2.28)	4.82 (2.31)	6.90 (2.72)	5.93 (2.54)	2.300
T-4	-	-	-	-	-	-	-	-	-
T-5	1.90 (1.55)	0.08 (1.14)	2.48 (1.73)	1.33 (1.35)	4.12 (2.15)	4.06 (2.14)	5.30 (2.41)	5.00 (2.35)	2.850
T-6	2.20 (1.64)	0.09 (1.18)	4.13 (2.15)	2.08 (1.61)	6.93 (2.73)	6.50 (2.65)	9.60 (3.18)	10.50 (3.32)	1.450
CD 5%	0.09	0.09	0.12	0.10	0.10	0.11	0.09	0.12	

Table 3.15: Incidence of pests recorded after spraying with new chemicals at Madakkathara

Treat ment	TMB Replication I		Replication II		Replication III		Leaf minor	Blossom webber	Apple & nut borer	Yield (kg/ tree)
	(%)	Score	(%)	Score	(%)	Score				
T1	2.6	0.11	1.6	0.12	2.5	0.24	1.25	1.15	1.44	5.000
T2	3.2	0.19	1.8	0.13	2.0	0.18	1.64	2.13	-	5.600
T3	1.8	0.05	1.3	0.09	1.7	0.14	1.55	0.90	0.96	6.500
T4	-	-	-	-	-	-	-	-	-	-
T5	1.6	0.08	1.0	0.09	1.3	0.09	0.95	0.65	0.35	8.800
T6	2.0	0.13	1.2	0.12	1.7	0.11	1.25	1.15	1.00	6.700



Table 3.16: Incidence of pests recorded after spraying with new chemicals at Vengurle

Treatment	Average per cent shoots/ panicles damaged 30 days after			Average nut surface damaged by flower thrips during stage		
	I spray	II spray	III spray	Pea nuts	Pebble nuts	Matured nuts
T1	0.74 (3.44)	3.94 (10.37)	23.28 (28.84)	16.57 (23.98)	25.25 (30.43)	26.23 (31.13)
T2	0.51 (2.90)	7.59 (15.79)	22.55 (28.10)	16.74 (24.14)	24.50 (29.62)	25.01 (30.29)
T3	0.52 (2.08)	3.62 (10.86)	20.23 (26.67)	14.64 (22.56)	25.98 (31.15)	25.05 (30.00)
T4	0.95 (2.27)	5.51 (13.31)	21.41 (27.50)	16.74 (24.15)	26.11 (30.73)	26.42 (31.53)
T5	1.93 (6.88)	13.75 (19.73)	37.38 (37.71)	24.01 (28.82)	35.69 (36.42)	39.38 (38.81)
S.E.±	2.233	1.956	1.360	0.524	1.091	0.762
C.D. at 5% N.S.		6.029	4.191	1.616	3.363	2.243

Table 3.17: Incidence of pests recorded after spraying with new chemicals at Vridhachalam

Treatment	TMB (Score) after 30 days		Leaf & Blossom Webber (%) after 30 days
	II spray	III spray	
T1	1.2	0.8	3.8
T2	1.8	1.6	4.1
T3	2.1	1.2	5.3
T4	1.6	1.3	5.8
T5	2.1	1.7	4.3
Control	3.4	3.7	14.8



Crop Prot.

Control of stem and root borer

Ent. 2

Expt. 1: Prophylactic control trial

Centres | East Coast : Bhubaneswar, Jhargram and Vridhachalam
 | West Coast : Madakkathara, and Vengurle

Summary

For control of cashew stem and root borer (CSRB) at Bhubaneswar, the treatment mud slurry + carbaryl swabbing along with lindane soil application was found to be better. Swabbing of neem oil and soil application of Sevidol 8G 75g tree⁻¹ was most effective prophylactic control tried in Jhargram. Neem oil 5% swabbing along with lindane 0.2% and Mud slurry + Carbaryl 0.2% at four intervals were found to be more effective in Madakkathara. At Vengurle, swabbing with neem oil 5% along with Sevidol 4G soil application was found to be promising. Swabbing coal tar thrice with the application of Lindane 0.2% was most effective treatment at Vridhachalam.

The objective 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 mud slurry + carbaryl

T4 Twice + Lindane 0.2%

T5 Thrice + Lindane 0.2%

T6 Four time + Lindane 0.2%

T7 Control

BHUBANESWAR

Among the treatments tried, mud slurry + carbaryl swabbing along with Lindane soil application (4%) was found to be better than

swabbing with neem oil (12%). Maximum infestation (28%) was observed in untreated control. The details of occurrence of CSRB in prophylactic trial are given in Table 3.18.



Table 3.18: Occurrence of CSRB in prophylactic trial at Bhubaneswar.

Treat ment	Infested trees (%)										Stages of infestation			
	Mar.	April	May	June	July	Aug.	Sept	Oct	Nov	Dec	Early	Middle	Adv	Dead
T1	0.0	4.0	0.0	0.0	8.0	8.0	12.0	0.0	8.0	8.0	-	4	4	-
T2	4.0	0.0	0.0	4.0	0.0	8.0	8.0	8.0	8.0	12.0	-	4	8	-
T3	4.0	0.0	4.0	0.0	0.0	12.0	0.0	4.0	4.0	4.0	8	-	4	-
T4	0.0	0.0	0.0	0.0	0.0	4.0	4.0	4.0	0.0	0.0	4	-	-	-
T5	4.0	0.0	0.0	12.0	0.0	12.0	12.0	12.0	0.0	4.0	8	4	-	-
T6	4.0	0.0	4.0	0.0	16.0	16.0	0.0	4.0	4.0	4.0	12	4	-	-
T7	0.0	20.0	20.0	24.0	24.0	28.0	28.0	28.0	28.0	28.0	4	12	8	4

JHARGRAM

Swabbing of neem oil (5%) and soil application of Sevidol 8G 75g/tree was most effective prophylactic control in two application schedules per year. The infestation of CSRB was negligible in T4 and T5. The occurrence of CSRB in prophylactic control experiment is Table 3.19.

MADAKKATHARA

Neem oil 5% swabbing at four intervals along with Lindane 0.2% (T3) and Mud slurry + Carbaryl 0.2% in an interval of four times an year were found to be more effective than other treatments. The occurrence of CSRB in prophylactic control treatment is presented in Table 3.20.

Table 3.19: Occurrence of CSRB in prophylactic trial at Jhargram

Treat ment	No. of trees	Trees with CSRB egg before treat ment	No. of trees infested after treat ment	% of infesta tion	Stages of infestation								
					Early		Middle		Advanced		Dead		
					No.	%	No.	%	No.	%	No.	%	
T2	25	5	-	-	-	-	-	-	-	-	-	-	-
T2	25	4	-	-	-	-	-	-	-	-	-	-	-
T3	25	5	-	-	-	-	-	-	-	-	-	-	-
T4	25	5	2	8	-	-	2	8	-	-	-	-	-
T5	25	4	1	4	-	-	-	-	-	-	-	-	-
T6	25	5	-	-	-	-	-	-	-	-	-	-	-
T7	25	5	5	20	1	4	3	12	1	4	-	-	-



Table 3.20: Occurrence of CSRB in prophylactic trial at Madakkathara

Treat ment	No. of trees infested											
	Jan.	Feb.*	Mar.	Apl.	May*	June	July	Aug.	Sept.*	Oct.	Nov.*	Dec.
T1	6	6	-	1	1	-	-	1	1	-	1	1
T2	2	-	-	-	-	-	-	-	1	-	-	1
T3	2	2	-	-	-	-	-	-	-	-	-	1
T4	4	4	-	-	-	-	-	1	1	-	-	1
T5	3	3	-	-	1	-	-	-	-	-	-	-
T6	1	1	-	-	-	-	-	-	-	-	-	1
T7	5	5	5	5	5	5	5	5	5	5	5	6

*Clearance and treatment application.

VENGURLE

The observations were recorded upto March 2000 and the first three treatments were discontinued due to unavailability of Sevidol 4G. New experiment was laid in October 2000 excluding first three treatments. From the data recorded in the earlier part of the year, swabbing

with neem oil 5% along with Sevidol 4G oil application under T2 and T3 were found to be promising. Swabbing with Mud slurry along with 0.2% Carbaryl and soil application of 0.2% Lindane was also found to be equally effective. The details of treatment against CSRB are presented in Table 3.21.

Table 3.21: Occurrence of CSRB in prophylactic trial at Vengurle

Treatments	No. of trees treated	No. of trees infested	Per cent infestation	Per cent prevention
T1	25	3	12	88
T2	25	1	4	96
T3	25	1	4	96
T4	25	2	8	92
T5	25	2	8	92
T6	25	1	4	96
T7	25	6	24	76

VRIDHACHALAM

The most effective treatment was swabbing coal tar thrice with the application of Lindane 0.2% (T5). The treatment T3 i.e.

swabbing neem oil 5% two times with soil application of Sevidol 75g/tree was also found to be equally good treatment.



Crop Prot.

Control of stem and root borer

Ent. 2

Expt. 1: Curative trial

Centres | East Coast : Bhubaneswar, Jhargram and Vridhachalam
| West Coast : Madakkathara, and Vengurle

Summary

The treatment mud slurry + carbaryl swabbing with Sevidol application (T2) was found better recovery percentage than other treatments at Bhubaneswar. The percentage of recovery was higher in T2 even in middle stages of CSRB attack and also higher in comparison to T3. At Madakkathara, maximum percentage of recovery of infested trees was seen in T1 treatment where neem oil 5% swabbing + Lindane 0.2% was given in early and middle stages of infestation. Swabbing with *Metarrhizium anisopliae* + 5% neem oil was also found to be equally effective. Swabbing Neem oil 5% with 2% Lindane soil application and swabbing neem oil 5% with *Metarrhizium anisopliae* during early stages was found to be effective in Vengurle. At Vridhachalam, extraction of grubs, swabbing of coal tar, soil application of Sevidol and *Metarrhizium anisopliae* in combination during the early stages of attack is found to be most effective.

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 + Sevidol 8 G 75g/tree
- T5 : T1 + T2 + *Metarrhizium anisopliae* - Spore suspension
- T6 : Control

Design : CRD

BHUBANESWAR

Out of various curative trials, the mud slurry + carbaryl swabbing with Sevidol (T2)

application was found to show better recovery percentage (74%) than the mud slurry + carbaryl with Lindane (T1) application (70%). The fungal treatment (T3) showed least recovery percentage (48%).



However, the plants treated during early stages of infestation showed higher recovery percentage (upto 100%) and those in the

terminal stage did not show any recovery. The data on curative control trial is presented in Table 3.22.

Table 3.22: Occurrence of CSRB under curative trial treatments at Bhubaneswar.

Treatment	No. of tree	Stages of attack						Recovery							
		Early		Middle		Advanced		Early		Middle		Advanced		Total	
		No	(%)	No	(%)	No	(%)	No	(%)	No	(%)	No	(%)	No	(%)
T1	33	18	55	10	30	5	15	16	89	5	50	0.0	0.0	23	70
T2	34	20	59	8	24	6	18	19	95	5	63	1	17	25	74
T3	25	10	40	8	32	7	28	10	100	2	25	0.0	0.0	12	48

JHARGRAM

The percentage of recovery was higher in T2 even in middle stages of CSRB attack. The percentage of recovery was also higher in comparison to T3. The treatment T3 was effective in early stages of infestation only. The details of occurrence of CSRB in curative trial are presented in Table 3.23.

MADAKKATHARA

Maximum percentage of recovery of infested trees was seen in T1 treatment where neem oil 5% swabbing + Lindane 0.2% was given in early and middle stages of infestation. Swabbing with *Metarrhizium anisopliae* + 5% neem oil was also found to be equally effective. In advanced stages of

infestation however, non of the treatments were effective. The data on curative control of CSRB is presented in Table 3.24.

VENGURLE

Maximum control of CSRB in infested trees was observed under both the treatments i.e. Swabbing Neem oil 5% with 2% Lindane soil application (T1) and swabbing neem oil 5% with *Metarrhizium anisopliae* (T2) during early stages. At middle stage of infestation 40% protection was observed with treatment T1 whereas 60% protection could be obtained with T2. At advanced stages both the treatments could give only 20% recovery. The data on curative control of CSRB in infested trees at Vengurle is presented in Table 3.25.

Table 3.23: Occurrence of CSRB under curative trial treatments at Jhargram.

Treatment	No. of trees	Stage of attack						Recovery stage					
		Early		Middle		Advanced		Early		Middle		Advanced	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
T1	25	5	20	5	20	2	8	4	16	3	12	-	-
T2	25	5	20	5	20	2	8	5	20	4	16	-	-
T3	25	6	24	4	16	1	4	3	16	2	8	-	-
T4	25	5	20	5	20	2	8	1	4	-	-	-	-



Table 3.24: Occurrence of CSRB under curative trial treatments at Madakkathara.

Treat ment	No. of trees	Stage of attack						Recovery stage					
		Early		Middle		Advanced		Early		Middle		Advanced	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
T1	6	2	8	3	12	1	4	2	80	21	60	1	<10
T2	6	3	12	3	12	-	-	3	40	2	<20	-	-
T3	6	2	4	2	4	2	4	2	60	2	40	2	<10

Table 3.25: Occurrence of CSRB under curative trial treatments at Vengurle.

Treat ment	No. of trees treated			No. of trees recovered			Stage wise recovery (%)		
	Early	Middle	Advance	Early	Middle	Advance	Early	Middle	Advance
T1	5	5	5	5	2	1	100	40	20
T2	5	5	5	5	3	1	100	60	20

VRIDHACHALAM

The practices such as extraction grubs, swabbing of coal tar, soil application of sevidol and *Metarrhizium anisopliae* in combination during the early stages of attack

in the young trees was the most practical solution for curative trial of CSRB attacked cashew trees. The occurrence of CSRB at Vridhachalam under curative trial is presented in Table 3.26.

Table 3.26: Occurrence of CSRB under curative trial treatments at Vridhachalam

TREATMENT	Total No. of tree treated	Stage of attack (No.)			Recovery (No.)		
		Early	Middle	Advanced	Early	Middle	Advanced
T ₁ Extraction of grubs	16	4	3	3	4	1	-
T ₂ - Swabbing twice (coal tar : Kerosene)	14	4	3	3	4	1	-
T ₃ - 1+2 Lindane 20 EC 2% soil drenching	10	4	3	3	4	2	-
T ₄ 1+2 + Sevidol 75 g soil application	18	3	4	3	3	1	-
T ₅ 1+2 + <i>Metarrhizium anisopliae</i> spawn	16	4	3	3	6	2	-



Crop Prot.

Ent. 3

Bio-ecology of pests of regional importance and survey of pest complex and natural enemies

Centres	East Coast	: Bhubaneswar, Jhargram and Vridhachalam
	West Coast	: Madakkathara, and Vengurle
	Maidan tract	: Chintamani and Jagdalpur

Many pests have been identified infesting cashew plants during various cropping seasons. The common name and scientific name of pests infesting cashew are given below.

Aphids - <i>Toxoptera odinae</i>	Leaf miner - <i>Acrocercops syngamma</i>
Apple and nut borer - <i>Nephoteryx</i> sp.	Leaf thrips - <i>Rhipiphorothrips cruentatus</i>
Bark eating caterpillar - <i>Indarbela tetraonis</i>	Leaf thrips - <i>Selenothrips rubrocinctus</i>
Black thrips - <i>Haplothrips ceylonicus</i>	Leaf weevils - <i>Mylocerus discolor</i>
Blister beetle - <i>Zonabris pustulata</i>	Mealy bug - <i>Ferrisia virgata</i>
Cetonid beetles - <i>Heterothinus elegans</i>	Nut crinckler - <i>Paradesymus rostratus</i>
Cetonid beetles - <i>Oxycetonia versicolor</i>	Paddle legged bug - <i>Anoplochneis phaseana</i>
Fruit and nut borer - <i>Thylecoptila panerosema</i>	Red-banded wasp - <i>Vespa tineta</i>
Green plant bug - <i>Neazara viridula</i>	Shoot tip caterpillar - <i>Cheleria haligramma</i>
Hairy caterpillar - <i>Metanastria hyartica</i>	Shoot tip caterpillar - <i>Hypatima haligramma</i>
Inflorescence thrips - <i>Rhynchothrips raoensis</i>	Spittle bug - <i>Eurybrachis tomentosus</i>
Inflorescence thrips - <i>Sciriothrips dorsalis</i>	Stem and root borer - <i>Plocaederus ferrugineus</i>
Leaf and blossom webber - <i>Lamida monocusalis</i>	Tea mosquito bug - <i>Helopeltis antonii</i>
Leaf beetle - <i>Monolepta longitarsus</i>	Termites - <i>Odontotermus obesus</i>
Leaf folder - <i>Dudua approbata</i>	Tree hopper - <i>Oxyrachis terrandus</i>
Leaf folder - <i>Caloptilia tiscelaea</i>	Yellow thrips - <i>Frankliniella schultzei</i>

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

BHUBANESWAR

Observations on major pests and natural enemies was done in comparison with the ecological factors in selected trees from January 2000 to December 2000 and the data is presented in Table 3.27.

The shoot caterpillar (*Hypatima haligramma* M.) was active during January to February and from July to December, the peak incidence of the pest (10.64%) during second fortnight of October. Leaf beetle (*Menolepta longitarsus* Jac.) was found during June and July coinciding with new flushes



after the onset of southwest monsoon. Peak period was the first fortnight of July. Leaf minor (*Acrocercops syngramma* M.) was present during July to December with a peak (53.65%) in second fortnight of October. Apple and nut borer (*Nephopteryx* Sp.) was observed during April with a peak (3.13%) in the first fortnight. Yellow and Black inflorescence thrips (*Frankliniella schultzei* T and *Haplothrips ceylonicus* Sch. respectively) were also recorded. The later was observed from second fortnight of January to April with a maximum during the first fortnight of March (3.52%). The yellow thrips were observed from January to April with a maximum (3.35%) during first fortnight of February.

Besides the above pests, minor pests like leaf folder, brown aphid (*Toxaptera ordinae*), mealy bugs (*Ferrisia virjata* Cell), Gundhi bug (*Leptoconisa acuta* Thumb), hairy caterpillar, leaf and blossom webber (*Lamida moncusalis* L.), bark borer (*Indrabela tetraonis* M.) and termites (*Odomtotermis* Sp.) were also observed. But the extent of damage was negligible.

A study of field parasitisation of major insect pests on cashew indicated that shoot caterpillar, leaf and blossom webber and leaf minor were parasitized on an average to an extent of 6.7, 7.2 and 8.6% respectively. *Brecon brevicornis* parasitized (12%) on leaf and blossom webber during second fortnight of October and first fortnight of May. *Elasmus* species parasitized on shoot tip caterpillar

(10%) during October and *Sympiesis* species on leaf minor during October. The other predators present in cashew ecosystem were spiders, lady bird beetle, *Verania cinta* Gorh., *Memochilus sexmaculata* F.), black ant, mirid bug etc. The population of these predators is presented in Table 3.28.

CHINTAMANI

The tea mosquito bug was observed from the third week of September to second week of April. Maximum tea mosquito bug population (28.43%) was seen in the fourth week of December. It was found to be feeding on guava from July to September and on neem from September to January. Leaf miners were found from first week of August to last week of December with a maximum of 48.03% during fourth week of November. Leaf and blossom webber was observed from first week of August to last week of December with a peak during fourth week of December (11.68%). Inflorescence thrips were found from the first week of April to third week of June with a peak incidence (19.03 No./panicle) in first week of April. Fruit and nut borer was noticed during the third week of March and reached maximum of 16.08% during third week of May and there after sudden reduction was noticed. A total of eighteen insect species feeding and breeding on different parts of cashew tree have been recorded. The seasonal occurrence of major pests of cashew at Chintamani is presented in Table 3.29.



Table 3.27: Seasonal occurrence of pests and predators of cashew at Bhubaneswar

Month	Wks	Pests											
		Shoot caterpillar (%)	Leaf beetle (%)		Leaf Miner (%)		ANB	Inflorescence thrips		Thrips score	ANB	Leaf folder (%)	CSRB
			Shts	Lvs	Shts	Lvs		YT	BT				
Jan	I	0.61	—	—	—	—	—	0.52	—	—	—	—	3
	II	1.65	—	—	—	—	—	0.99	0.11	—	—	—	3
Feb	I	3.50	—	—	—	—	—	3.35	0.27	—	—	—	3
	II	1.21	—	—	—	—	—	2.52	1.31	—	—	—	9
Mar	I	—	—	—	—	—	—	1.96	3.52	—	—	—	10
	II	—	—	—	—	—	—	0.99	2.99	0.22	1.60	—	10
April	I	—	—	—	—	—	—	0.55	0.66	0.46	4.45	—	10
	II	—	—	—	—	—	—	0.29	0.21	0.31	3.00	—	11
May	I	—	—	—	—	—	—	—	—	0.22	0.20	—	11
	II	—	—	—	—	—	—	—	—	0.18	—	—	12
June	I	—	—	—	—	—	—	—	—	—	—	—	12
	II	—	2.05	43.05	—	—	—	—	—	—	—	—	13
July	I	0.77	2.05	57.75	0.67	45.60	—	—	—	—	—	—	13
	II	1.44	1.55	32.50	2.44	34.80	—	—	—	—	—	—	13
Aug	I	1.75	—	—	3.66	35.70	—	—	—	—	—	—	13
	II	2.37	—	—	5.20	40.12	—	—	—	—	—	—	14
Sept.	I	3.05	—	—	6.50	45.50	—	—	—	—	—	3.70	14
	II	3.88	—	—	9.50	56.60	—	—	—	—	—	6.80	14
Oct.	I	5.82	—	—	11.55	60.50	—	—	—	—	—	10.70	14
	II	10.64	—	—	13.80	53.65	—	—	—	—	—	14.5	15
Nov.	I	9.10	—	—	9.15	49.80	—	—	—	—	—	7.50	15
	II	3.82	—	—	5.30	42.57	—	—	—	—	—	2.95	15
Dec.	I	2.66	—	—	3.70	39.00	—	—	—	—	—	2.69	15
	II	2.44	—	—	2.45	29.05	—	—	—	—	—	2.75	15

YT = Yellow thrips, BT = Black thrips, ANB = Apple & Nut Borer.

PREDICTION EQUATIONS DEVELOPED BY CHINTAMANI FOR TMB INFESTATION

The prediction equations were derived through multiple regression analysis for each year as well as pooled data for all the ten years with respect to TMB population (From 1988-1994 and 1996-98). It revealed that

it accounts for 84, 67, 78, 88, 62, 59, 64, 90, 85, 70 and 53 per cent variability from 1988 to 1994, 1996 to 1998 and the pooled, respectively in case of TMB population. The prediction equation is as follows:

In case of pest population, the regression equation is as follows:

$$Y (1988) = 0.392 x_1 + 0.003x_2 + 0.096x_3 - 0.060 x_4 - 0.025 x_5 - 1.117 x_6 - 0.045 x_7 + 18.275 (R^2=0.84)$$

$$Y (1989) = 1.046 x_1 - 0.014 x_2 + 0.013x_3 - 0.172 x_4 - 2.262 x_5 + 0.204 x_6 - 0.417 x_7 + 67.869 (R^2=0.67)$$



$$\begin{aligned} Y(1990) &= 1.469 x_1 - 0.069x_2 + 0.196x_3 + 0.094 x_4 - 0.814 x_5 - 1.532 x_6 + 1.524 x_7 + 28.33 (R^2=0.78) \\ Y(1991) &= 0.782 x_1 + 0.0200x_2 + 0.364x_3 - 0.240 x_4 - 0.502 x_5 - 1.699 x_6 - 0.405 x_7 + 33.766 (R^2=0.88) \\ Y(1992) &= 0.808 x_1 + 0.006x_2 + 0.0213x_3 - 0.263 x_4 - 0.315 x_5 - 0.453 x_6 + 0.349 x_7 + 28.018 (R^2=0.62) \\ Y(1993) &= 0.677 x_1 - 0.009x_2 - 0.029x_3 + 0.170 x_4 - 0.425 x_5 - 0.317 x_6 - 0.437 x_7 + 10.738 (R^2=0.59) \\ Y(1994) &= 0.099 x_1 - 0.036x_2 - 0.047x_3 + 0.042 x_4 - 0.353 x_5 - 0.555 x_6 + 0.281 x_7 + 23.281 (R^2=0.64) \\ Y(1996) &= -0.003 x_1 - 0.003x_2 + 0.011x_3 - 0.265 x_4 - 0.817 x_5 - 0.531 x_6 + 0.169 x_7 + 48.999 (R^2=0.90) \\ Y(1997) &= 0.241 x_1 - 0.014 x_2 - 0.040x_3 - 0.139 x_4 - 0.155 x_5 - 1.574 x_6 + 0.684 x_7 + 44.492 (R^2=0.85) \\ Y(1998) &= -0.066 x_1 + 0.004x_2 + 0.160x_3 - 0.103 x_4 + 0.400 x_5 - 1.524 x_6 - 0.661 x_7 + 14.920 (R^2=0.70) \\ Y(\text{Pooled}) &= 0.648 x_1 + 0.002x_2 + 0.048x_3 - 0.073 x_4 - 0.642 x_5 - 0.597 x_6 - 0.272 x_7 + 30.473 (R^2=0.53) \end{aligned}$$

Where,

Y = Predicted TMB population; x_1 = Sunshine hours (h/day)
 x_2 = Rainfall (mm); x_3 = Morning relative humidity (%)
 x_4 = Evening relative humidity (%); x_5 = Maximum temperature ($^{\circ}$ C)
 x_6 = Minimum temperature ($^{\circ}$ C); x_7 = Number of rainy days

In case of percentage damage due to TMB, the regression equation is as follows:

$$\begin{aligned} Y(1988) &= 0.563 x_1 + 0.002x_2 + 0.124x_3 - 0.188 x_4 - 0.688 x_5 - 1.690 x_6 - 0.338 x_7 + 56.929 (R^2=0.87) \\ Y(1989) &= 2.602 x_1 - 0.034 x_2 + 0.140x_3 - 0.335 x_4 - 4.823 x_5 + 0.383 x_6 - 0.935 x_7 + 133.926 (R^2=0.68) \\ Y(1990) &= 3.133 x_1 - 0.158x_2 + 0.190x_3 + 0.199 x_4 - 1.635 x_5 - 4.179 x_6 + 3.643 x_7 + 94.777 (R^2=0.83) \\ Y(1991) &= 2.085 x_1 + 0.088x_2 + 1.193x_3 - 0.712 x_4 - 1.572 x_5 - 4.258 x_6 - 2.007 x_7 + 81.118 (R^2=0.88) \\ Y(1992) &= 3.011 x_1 - 0.012x_2 - 0.220x_3 - 0.667 x_4 - 1.855 x_5 - 0.715 x_6 + 0.947 x_7 + 110.338 (R^2=0.61) \\ Y(1993) &= 2.007 x_1 - 0.062x_2 - 0.001x_3 + 0.044 x_4 - 0.768 x_5 - 1.169 x_6 - 0.198 x_7 + 17.92 (R^2=0.64) \\ Y(1994) &= 0.136 x_1 - 0.114 x_2 - 0.120x_3 + 0.086 x_4 - 1.077 x_5 - 1.372 x_6 + 0.938 x_7 + 65.677 (R^2=0.68) \\ Y(1996) &= 0.298 x_1 - 0.009x_2 + 0.161x_3 - 0.803 x_4 - 2.649 x_5 - 1.409 x_6 + 0.206 x_7 + 139.569 (R^2=0.89) \\ Y(1997) &= 0.897 x_1 - 0.019 x_2 - 0.129x_3 - 0.434 x_4 - 1.466 x_5 - 3.969 x_6 + 1.688 x_7 + 149.758 (R^2=0.87) \\ Y(1998) &= 0.221 x_1 + 0.00003x_2 + 0.507x_3 - 0.304 x_4 + 0.911 x_5 - 4.355 x_6 - 1.749 x_7 + 47.063 (R^2=0.73) \\ Y(\text{Pooled}) &= 1.738 x_1 + 0.013x_2 + 0.138x_3 - 0.230 x_4 - 1.762 x_5 - 1.589 x_6 - 0.791 x_7 + 83.629 (R^2=0.54) \end{aligned}$$

Where,

Y = Percentage damage due to TMB population;
 x_1 = Sunshine hours (h/day); x_2 = Rainfall (mm)
 x_3 = Morning relative humidity (%); x_4 = Evening relative humidity (%)
 x_5 = Maximum temperature ($^{\circ}$ C); x_6 = Minimum temperature ($^{\circ}$ C)
 x_7 = Number of rainy days



Both the regression equations explained greater than 50 per cent accountability in pest build up of TMB as well as per cent damage. However, it accounts up to 90 per cent on individual years based on optimum weather conditions and varied between 59 and 90 per cent during the study period.

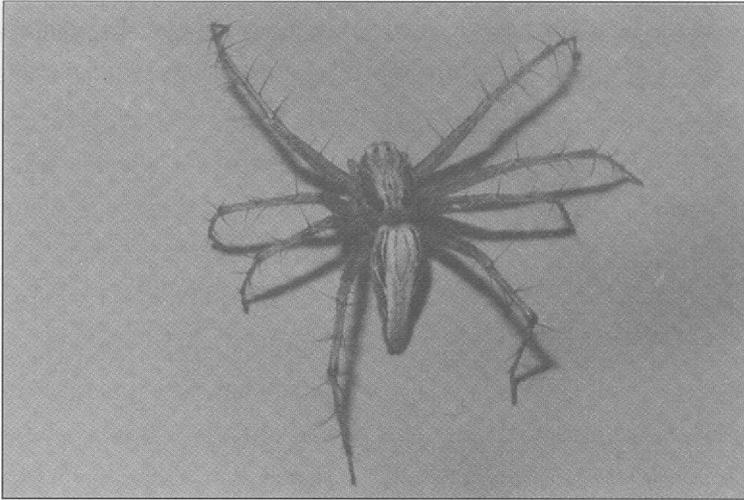
JAGDALPUR

Survey was conducted in the neighbouring locations of Jagdalpur namely, Bastar, Bakawand, Tokapal and Jagdalpur block of forest plantations for pest of cashew in January to December 2000. At Jagdalpur highest infestation was found by CSRB on cashew trees followed by termite and TMB. The predators and parasites present in cashew eco-system were spiders, preying mantid, reduvid bug, black ant, wasp, ladybird beetle and Apantales. Seasonal occurrence of pest and their natural enemies is presented in Table 3.29.

JHARGRAM

Stem and root borer was the severe pest in neglected plantations in West Bengal. The pest was recorded throughout the year.

The TMB was recorded during the month of October however the population was below harmful level. Maximum population of TMB was recorded (1.8%) during January. Shoot and blossom webber was recorded from January to March and August to December. Peak period of infestation was up to March. Incidence of shoot tip caterpillar was found during January to April and August to December. The peak period of incidence was during February and September. The thrips were observed during January to April. Both leaf thrips and inflorescence thrips were noticed in cashew trees. The period of maximum attack due to thrips was during March. The infestation of leaf miner incidence was high during October (10.8%) coinciding with new flush formation. Apple and nut borer was recorded during March to May, but its population was very low. Termites were found damaging the plant in red and laterite zones but the population was low. The incidence of leaf folder was noticed in flushing stage. Only few localized infestation were noticed in certain localities. The data on occurrence of pests is correlated with weather parameters at Jhargram in Table 3.30.



Two spider species : *Oxyopes shweta* Tikadar, and
Plexippus paykalli (Aud) from Chintamani

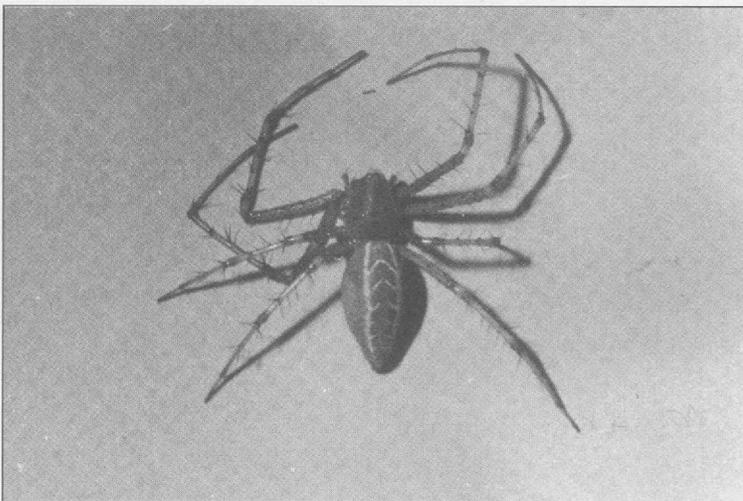




Table 3.28: Seasonal occurrence of pests of cashew at Chintamani.

Months	Week	TMB (%)	Leaf miner (%)	Leaf & Blossom webber (%)	Inflorescence thrips No./infl	Fruit & Nut borer (%)
Jan.	I	—	—	—	—	—
	II	0.13	—	—	—	—
	III	2.23	—	—	—	—
	IV	6.43	—	—	—	—
Feb	I	10.02	—	—	—	—
	II	14.06	—	—	—	—
	III	16.93	—	—	—	—
	IV	12.62	—	—	1.36	—
Mar	I	9.83	—	—	2.86	—
	II	7.42	—	—	4.32	—
	III	5.31	—	—	6.94	—
	IV	4.62	—	—	8.83	—
April	I	3.02	—	—	10.06	—
	II	1.04	—	—	14.12	—
	III	—	—	—	16.62	1.02
	IV	—	—	—	18.02	3.06
May	I	—	—	—	17.42	5.42
	II	—	—	—	19.03	6.98
	III	—	—	—	14.02	8.92
	IV	—	—	—	12.04	10.02
June	I	—	—	—	14.11	11.12
	II	—	—	—	13.04	13.11
	III	—	—	—	8.96	14.83
	IV	—	—	—	7.42	16.08
	V	—	—	—	6.02	15.12
July	I	—	—	—	4.01	6.08
	II	—	—	—	2.03	2.02
	III	—	—	—	—	0.12
	IV	—	—	—	—	—
August	I	—	0.12	—	—	—
	II	—	1.62	—	—	—
	III	—	3.92	—	—	—
	IV	—	6.62	—	—	—
	V	—	8.93	—	0.31	—
Sept.	I	—	10.42	0.62	—	—
	II	—	12.82	0.98	—	—
	III	0.32	16.62	1.02	—	—
	IV	0.74	20.11	1.36	—	—
Oct	I	0.98	24.43	2.12	—	—
	II	1.43	28.62	3.46	—	—
	III	2.41	30.14	5.61	—	—
	IV	3.42	34.63	6.98	—	—
Nov	I	5.21	38.48	7.36	—	—
	II	6.82	40.63	7.98	—	—
	III	9.93	42.14	8.43	—	—
	IV	11.63	46.01	8.99	—	—
	V	14.42	48.03	9.63	—	—
Dec	I	17.81	42.02	10.32	—	—
	II	20.63	36.12	10.68	—	—
	III	23.41	28.14	9.36	—	—
	IV	28.43	22.02	11.68	—	—



Table 3.29: Seasonal occurrence of pests and natural enemies at Jagdalpur.

Pests	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
CSRB	4.0	4.0	5.0	10.0	10.0	8.0	—	—	—	4.0	—	—
Termite	4.0	8.0	4.0	5.0	5.0	4.0	—	—	—	4.0	6.0	18.0
TMB	6.0	24.0	48.0	46.0	38.0	—	—	—	—	—	—	—
P.mantid	2.0	8.0	9.8	9.2	8.0	—	—	—	—	—	—	—
R. bug	2.0	3.0	4.0	1.0	—	—	—	—	—	—	—	—
Spider	4.0	10.0	5.0	8.0	10.2	4.2	—	—	—	—	—	—
L.folder	—	—	4.0	5.7	6.7	8.5	6.8	—	—	—	—	—
L&B webber	—	—	4.6	3.8	2.8	—	—	—	—	—	—	—
Aphid	—	—	—	2.4	2.8	8.4	8.9	—	—	4.6	10.0	—
A&N borer	—	—	—	2.4	8.4	—	—	—	—	—	—	—
Wasp	—	—	2.0	0.2	2.0	—	—	—	—	—	—	—

Table 3.30: Correlation of weather parameters with pests of cashew at Jhargram.

Month	Temp (°C)		RH		Rain fall (mm)	No. of Rainy days	Percentage damage					
	Max	Min	AM	PM			TMB	BW	LM	Thrips	ANB	STC
Jan.	24.6	12.3	79.8	48.3	9.0	2	1.8	1.0	1.5	1.0	—	5.2
Feb	26.2	18.0	79.2	49.3	2.1	2	1.4	0.6	8.2	9.3	—	7.5
March	31.4	21.0	74.0	49.5	15.8	4	0.6	0.4	3.1	10.5	1.0	5.2
April	35.1	21.5	75.6	44.0	22.0	5	—	—	—	7.3	2.8	0.4
May	37.1	24.0	80.0	45.1	40.3	6	—	—	—	—	0.9	—
June	36.3	23.5	80.2	50.0	94.8	8	—	—	—	—	—	—
July	35.4	23.2	90.8	74.8	240.5	15	—	—	—	—	—	—
Aug.	36.1	23.9	90.5	72.6	270.3	20	—	1.0	0.8	—	1.6	—
Sept.	35.8	25.4	87.1	68.1	320.2	16	—	6.5	5.3	—	—	10.5
Oct.	31.2	22.5	83.6	51.3	180.1	12	0.2	12.6	10.8	—	—	6.2
Nov.	28.6	15.0	82.0	45.7	30.8	5	0.8	10.4	6.5	—	—	3.1
Dec.	26.0	11.0	74.8	41.2	13.2	4	1.2	4.3	1.0	—	—	1.3

TMB = Tea mosquito bug BW = Shoot and blossom webber LM = Leaf miner
 ANB = Apple and nut borer STC = Shoot tip caterpillar

MADAKKATHARA

The tea mosquito infestation was comparatively less during the year. However, low population of TMB was noticed throughout the year except June, July and August. The minor pests recorded were leaf miner (July to October), ranging from 1.33 to 3.75, leaf roller during August - October ranging from 1.25 to 1.85, blossom webber

from January to March ranging from 2.55 to 4.7 and infestation of apple and nut borer was comparatively high during January to May ranging from 9.85 to 16.5%.

The natural enemies and other agents noticed in the unsprayed area were ants, spiders, mirid bugs, chrysopa, honeybees, flies and wasps. The details of pests recorded are presented in Table 3.31 and 3.32.



Table 3.31: Seasonal occurrence of pests of cashew at Madakkathara.

Month	Temp (°C)		RH		Rain fall (mm)	No. of Rainy days	TMB					
	Max	Min	AM	PM			Shoots		Panicle		Nut	
							(%)	Score	(%)	Score	%	Score
Jan.	32.9	22.1	72	41	2.2	0	—	—	6.5	0.85	9.85	0.25
Feb.	35.0	22.5	77	38	2.4	0	—	—	11.55	1.11	10.33	3.30
March	36.2	23.8	82	42	7.4	1	—	—	—	—	11.45	0.22
April	35.7	25.1	84	54	61.1	4	—	—	—	—	11.55	0.19
May	34.0	24.9	87	61	164.3	7	—	—	—	—	—	—
June	30.3	23.3	93	78	754.9	23	—	—	—	—	—	—
July	29.1	22.9	94	80	709.3	24	—	—	—	—	—	—
Aug.	29.4	23.2	94	77	471.5	21	—	—	—	—	—	—
Sept.	30.4	23.3	92	70	260.0	40	0.15	0.05	—	—	—	—
Oct.	31.2	23.1	91	69	296.4	13	0.40	0.09	—	—	—	—
Nov.	31.7	22.8	84	62	112.2	5	0.60	0.07	—	—	—	—
Dec.	31.9	22.6	75	50	19.9	1	0.75	0.13	3.65	0.05	—	—

Table 3.32: Monthly occurrence of minor pests and natural enemies at Madakkathara.

Month	Leaf miner		Leaf Roller (%)	Blossom Webber (%)	Thrips (%)	ANB Score	Ants	Spider	Mirid bug	Chrysopa	Bees/flies/wasps	
	Shoot (%)	Leaves (%)										
Jan.	—	—	—	2.55	—	—	10.6	6.7	2.5	—	1.80	2.33
Feb.	—	—	—	4.65	—	—	9.85	5.8	2.0	—	2.00	3.50
Mar.	—	—	—	4.70	—	—	13.5	4.5	0.9	—	—	2.75
Apr.	—	—	—	—	—	—	16.55	4.8	1.6	—	—	1.33
May	—	—	—	—	—	—	11.33	6.5	2.5	—	—	0.95
June	—	—	—	—	—	—	—	1.5	—	—	—	—
July	—	1.33	—	—	—	—	—	0.95	0.80	3.7	—	—
Aug.	—	3.5	4.25	—	—	—	—	3.6	1.0	1.5	1.45	0.80
Sep.	—	3.75	2.5	—	—	—	—	4.7	2.5	1.0	0.93	1.33
Oct.	—	—	1.85	—	—	—	—	4.6	1.6	2.6	—	1.85
Nov.	—	—	—	—	—	—	—	6.4	1.85	—	0.40	2.90
Dec.	—	—	—	—	—	—	—	6.8	2.7	—	1.60	4.50

VENGURLE

Tea mosquito bug and flower thrips found to attack cashew trees severely during January to April. The leaf miner and CSRB

were found to infest cashew throughout the year but in low intensities. The flower thrips were found during the whole year whereas the attack was severe during January to March



and December months. The details of occurrence of various pests and natural enemies of cashew pests are presented below in Table 3.33.

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

Common Name	Scientific Name	Month of Occurrence	Intensity
Tea-mosquito	<i>Helopeltis antonii</i>	Jan.-March April May.- Dec.	Severe Moderate Low Severe.
Flower thrips	<i>Rhipiphorothrips</i> sp.	Jan.-March April May-Nov. Dec.	Severe Moderate Low Severe.
Stem and root-borer	<i>Plocaederus ferrugineus</i>	Throughout year	Low
Leaf miner	<i>Acrocercops syngramma</i>	Throughout year	Low
Aphid	<i>Toxoptera odinae</i>	Jan.-March	Low
Mealy bug	<i>Ferrisia virgata</i>	Feb.-March	Low
Leaf eating beetles	<i>Manolepta</i> sp. <i>Coenoblus</i> sp.	June-Aug	Low
Leaf cutting weevils	<i>Depous</i> <i>Marginatus</i>	June-Aug.	Low
Web worm	<i>Orthaga</i> <i>Exvinacae</i>	Oct.-Nov.	Low
Semilooper	-	Oct.-Nov.	Low
Apple and nut borer	<i>Nephopleryx</i> sp.	Jan.-April	Low

VRIDHACHALAM

The occurrence of pests and natural enemies was recorded in farmer's plantations at Pudukoorapettai Village. In the fields, observations were taken at every fortnight on the intensity of pest infestation and

their seasonal abundant (Table 3.34). The natural enemies of cashew and their hosts in the stage at which attacked, period of occurrence and their intensity is also presented in Table 3.35.



Table. 3.34: Occurrence of cashew pests at Vridhachalam.

Common Name	Scientific Name	Month of occurrence	Intesity %
Stem and Root borer	<i>Plocaederus ferrugineus</i>	Round the year	8.50
Tea Mosquito bug	<i>Helopeltis antonii</i>	March - April	3.80
Leaf miner	<i>Acrocercops syngamma</i>	Aug-Oct	7.40
Green leaf folder	<i>Sylepta aurantiacalis</i>	July-Sept	18.90
Pink leaf roller	<i>Anigraea albomaculata</i>	Nov-Feb	9.52
Leaf and Blossm webber	<i>Lamida monocusalis</i>	March-June	9.72
Shoot tip caterpillar	<i>Hypatima haligramma</i>	April-June	3.80
Diamond hairy caterpilar	<i>Metanastria hyrtaca</i>	Dec-March	17.70
Hairy caterpillar	<i>Lymantria abuscta</i>	—	—
Apple and nut borer	<i>Thylocoptila panroseme</i>	Feb-April	4.69
Leaf weevil	<i>Myloccerus sp.</i>	Round the year	2.51
Leaf twisting weevil	<i>Apoderus tranquebaricus</i>	Dec-March	1.08
Aphids	<i>Toxoptera odinae</i>	March	1.49
Tailed mealy bug	<i>Ferrisia virgata</i>	March-May	7.80
Oriental mealy bug	<i>Planococcus sp.</i>	—	—
Leaf thrips	<i>Rhipiphorothrips cruentatus</i>	July-August	3.48
Flower thrips	<i>Scirtothrips dorsalis</i>	April-May	8.50
Termites	<i>Odontotermes obesus</i>	Dec-Jan	5.50
Snail	<i>Cryptozona bistrialis</i> (Beck)	April-August	4.80



Table 3.35: Occurrence of natural enemies of pests of cashew at Vridhachalam

Natural enemy	Host	Stage of attack	Occurrence	Intensity
Parasitoids				
<i>Cotesia (Apanteles sp)</i>	Green leaf folder	Larval	Dec-Feb	46.00
<i>Brachymeria sp</i>	Diamond hairy caterpillar	Pupae	Feb-April	12.00
Predators				
<i>Menochilus sexmaculatus</i>	Aphids Thrips	Adult and Nymphs	Feb-March	1.25
<i>Scymnus sp</i>	Mealy bugs	Adults and Nymphs	April-June	2.30
<i>Chrysopeia comea</i>	Mealy bugs Nymphs	April-June	3.90	
Preying Mantids	Leaf folder leaf and blossom webber	Adult	Oct-March	1.45
Spiders	Leaf folder leaf and blossom webber	Adult	Sep-April	1.40
<i>Metarhizum anisopliae</i>	Stem and root borer	Grub & pupae	Oct-Feb	13.80
<i>Beauveria bassiana</i>	Stem and root borer	Grub & pupae	Oct-Feb	11.00



Crop Prot.

Ent. 4

Screening of germplasm to locate tolerant / resistant types to major pests of the region

Centres	East Coast	: Bhubaneswar, Jhargram and Vridhachalam
	West Coast	: Madakkathara, and Vengurle
	Maidan tract	: Chintamani

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

BHUBANESWAR

Screening of MLT-86 accessions against the resistance/ tolerance to shoot tip caterpillar revealed that out of the 16 accessions tested, none of the cashew types were found resistant to shoot tip caterpillar during its peak activity. BPP-3/33 in MLT - 92 and V-4 in MLT 86 showed lowest damage (14.17 and 3.5% respectively). Whereas, H 320 in MLT 92 and VTH 59/2 in MLT 86 were highly susceptible to above pest.

The accessions in the germplasm were also tested against the tolerance/ resistance and out of the 70 accessions tested it was found that the accession OC-58 was least infested by shoot tip caterpillar (2.17%) followed by OC-65 and OC-57 (2.95 - 3.49%) infestation. The accession OC-26 showed high susceptibility (22.71%) followed by OC-20 (21.54%). The data on shoot tip caterpillar infestation in screening trial of MLT varieties is given in Table 3.36.

CHINTAMANI

The grafts of released varieties namely, V-1, V-2, V-3, V-4, V-5, BPP-1, BPP-3, BPP-4, BPP-5, BPP-6, Ullal-1, Ullal-3, Ullal-4, Chintamani-1 and NRCC - 2 were exposed to second instar nymphs of TMB for 48 hours under caged condition. The results revealed that non of the varieties were resistant/tolerant to this pest.

JHARGRAM

Eight germplasm accessions were screened against inflorescence thrips and shoot tip caterpillar. The hybrid 2/11 showed least attack by shoot tip caterpillar (3.8%) and Ansur-1 showed least damage due to inflorescence thrips (3.3%). The highest damage due to shoot tip caterpillar was observed in Digha-6 (6.8%) and 13/5 Kodur showed highest inflorescence thrips attack (5.8%). The data is presented in Table 3.37.



Table 3.36: Screening of MLT varieties for shoot tip caterpillar infestation at Bhubaneswar

Varieties in MLT 92	Shoot tip caterpillar infestation (%)	Varieties in MLT 86	Shoot tip caterpillar infestation (%)
M 44/3	7.16 - 24.35	T 129	1.50 - 5.46
M 15/4	2.54 - 28.57	H 1608	1.70 - 4.10
BPP 30/1	2.12 - 26.93	V-4	2.50 - 3.50
H 368	2.96 - 26.87	H 2/16	1.39 - 20.52
H 302	4.92 - 19.73	M 26/2	6.80 - 15.53
H 255	1.75 - 16.56	V-3	6.98 - 16.38
BPP 3/28	0.44 - 16.40	H 1610	6.87 - 13.45
H 320	2.82 - 28.58	V-2	3.74 - 18.21
H 68	1.36 - 15.74	BPP 40	9.73 - 12.36
BPP 3/33	4.80 - 14.17	M 1600	5.49 - 21.45
BPP 10/19	3.85 - 14.45	VTH 44/3	1.33 - 4.16
NRCC - 2	9.07 - 22.30	VTH 30/4	1.74 - 5.51
NRCC - 1	15.67 - 23.06	M 44/3	2.67 - 6.49
—	—	H 7/15	3.87 - 9.75
—	—	H 1598	1.24 - 5.79
—	—	VTH 59/2	3.61 - 24.26

Table 3.37: Screening of cashew accessions for tolerance to pests at Jhargram

Accession	Shoot tip caterpillar (%)	Inflorescence thrips (%)
Hybrid 2/11	3.8	5.3
Sawantwadi	4.2	4.9
NDR 2-1	5.6	3.6
13/5 Kodur	4.6	5.8
Ansur Early	5.9	4.6
Assam-8	3.9	5.5
Digha-6	6.8	4.2

MADAKKATHARA

Caging experiments were conducted on grafts of five released varieties for testing tolerance to TMB. Caging of two insects per cage resulted in feeding of leaves, the data of which is presented in Table 3.38.

VENGURLE

Two released varieties and three

hybrids were screened against TMB and the damage was recorded as percentage incidence and mean score. Highest damage was observed in V-7 (36.52% and 1.96 score) followed by H 367 (35.39% and 1.41 score). Least damage was observed in V-6 (17.96% and 0.71 score). The data on screening of germplasm against TMB is presented in Table 3.39.



Table 3.38: Screening of cashew varieties for TMB infestation at Madakkathara

Varieties	Score
Madakkathara-1	2-3
H 3-17	1-7
Madakkathara-2	2-3
H 1591	2-3
Goa 11/6	2-3

VRIDHACHALAM

F1 hybrids of high yielding varieties and TMB field tolerant types were screened for natural incidence of TMB. Lowest incidence of TMB was observed in M 26/2 x M 26/1 (H 13) with a mean score of 1.10 and highest damage was observed in M 44/3 x M 45/1 (H 17) with a mean score of 2.25.

Table 3.39: Screening of germplasm against TMB at Vengurle.

Name of variety/hybrid	Tea mosquito intensity	
	Avg. Score	%incidence
V-6	0.71	17.96
V-7	1.96	36.52
H-367	1.41	35.39
H-303	1.13	28.46
H-320	0.90	22.50

The observation recorded from field confinement tests are presented in Table 3.40. The MLT entries and germplasm types were also screened against the pests of cashew. The mean score of damage by TMB in MLT entries ranged from 1.10 - 2.60. Among the MLT entries, H 1608 has shown least damage to TMB (6.85% damage) under Vridhachalam conditions.

Table 3.40: Screening of F1 hybrids against various pests of cashew at Vridhachalam.

Cross Combination	Hybrid No	TMB mean score	Mean percent damage of shoot quadrant				Mean % damage of thrips per quadrant	
			Leaf and Blossom Webber	Leaf Folder	Hairy caterpillar	Mealy bug	Leaf damage	Nut damage
M 10/4 X M 26/1	H 10	1.50	17.20	16.00	-	-	11.00	1.70
M 10/4 X M 45/4	H 11	1.30	21.50	29.50	-	5.90	10.00	-
M 10/4 X M 75/3	H 12	1.50	16.00	32.00	19.00	4.50	7.75	-
M 26/2 X M 26/1	H 13	1.10	17.00	22.00	-	-	16.00	1.5
M 26/2 X M 45/4	H 14	1.70	18.75	19.00	-	5.50	11.85	1.80
M 26/2 X M 75/3	H 15	1.85	14.75	36.00	13.00	-	18.00	2.50
MM 44/3 X M 26/1	H 16	2.35	11.25	35.00	11.00	-	10.75	1.75
M 44/3 X M 45/1	H 17	2.40	15.50	-	-	-	5.80	-



(a) HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices and Nut Improvement Project (AICS & NIP) started during the fourth five Year Plan (1971) in which five centres (four regional centres and one ICAR-institute centre) were identified for conducting research on cashew. These centres were located at Bapatla (Andhra Pradesh), Palayam (Tamil Nadu), Anakkayam (later shifted to Madakkathara), Mumbai (Maharashtra) and CPCRI, Regional Centre, Bidar (Karnataka).

During the fifth plan period, one centre was added 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 added. The headquarters of the project were located at Central Plantation Crops Research Institute, Kasaragod. During the eighth Plan period, the Project was restructured into:

All India Coordinated Cashew Nut Improvement Project. The headquarters of the independent cashew project was shifted to Central Research Centre for Cashew, Bidar in 1986.

All India Coordinated Spices and Nut 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 increase production and productivity through:

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

The first Workshop of All India Coordinated Spices and Cashew nut Improvement Project was held at Kasaragod in October 1971 in which the research programmes were drawn up, identifying the problems and fixing the priorities. Subsequently, the progress of work was reviewed and research programmes modified / added as per the need in the Workshops held in Trivandrum, Kerala (1972); Coimbatore, Tamil Nadu (1975); Panjim, Goa (1978); Trichur, Kerala (1981); Calicut, Kerala (1983); Trivandrum, Kerala (1985);



Bhubaneswar, Orissa (1987); Coimbatore, Tamil Nadu (1989); National Group discussion in lieu of X Biennial Workshop at Kasaragod, Kerala (1991); Bangalore, Karnataka (1993), Kasaragod, Kerala (1995) and Dapoli, Maharashtra (1997) and Bhubaneswar, Orissa (1999). Two group discussions were also held one in horticulture at CPCRI, Regional Station, Vittal (1986) and other in entomology at Trichur (1988). On 21st January 2000 a group discussion was held at Cashew Research Station, Madakkathara to discuss about High density planting with different levels of fertilizer and pruning in cashew plantation and Soil fertility based fertilizer recommendations.

The significant achievements of the project are summarized below:

1. During the year 36 accessions were collected by the Coordinating centres of which 22 were field planted bringing the total collection to 1128.
2. Among the germplasm accessions evaluated at Bhubaneswar, the maximum yield was recorded in OC - 65 with a yield of 3.60 kg/tree. At Chintamani, the highest yield (16.10 kg/tree) was reported for 44/5 ARSC (V-5). At Jagdalpur, highest yield was recorded for NRC-138 (380g/tree). Highest yield for JGM 74/6 (14.79 kg/tree) at Jhargram. The highest yield recorded was 3.1 kg for H 1600 at Madakkathara. Among the new germplasm, M 89/2 has given the
3. Among the released varieties evaluated, the data indicated that the BPP-9 followed by V-5 showed highest number of bisexual flowers at Bapatla conditions. At Jagdalpur, Vnengurla-4 performed well (1.0 kg/tree) among the 14 released varieties tested. Among the 24 released varieties tested, maximum yield was observed for BPP-5 (1.60 kg/tree) at Madakkathara.
4. The nut yield was highest in Vengurla-3 (11.08 kg/tree) at Chintamani under comparative yield trial. During the year under MLT 86 the yield was significantly high in M 44/3 (5.93 kg/tree) at Chintamani. Highest nut yield per tree was recorded for H 2/16 (8.80 kg) at Jhargram. Highest yield was reported for V-5 (12.56 kg/tree) from Madakkathara.
5. Among the varieties tested under multilocation trial - 92, highest yield was obtained for variety 30/1 (2.80 kg/tree) at Bapatla. Maximum yield was obtained for H 367 (5.64 kg/tree) at Bhubaneswar. At Chintamani, maximum plant height (4.98 m) and maximum yield (5.52 kg/tree) were recorded for Hy 302. Maximum plant height (2.90 m) and yield (1.59 kg/



tree) were observed in H 303 at Jagdalpur. At Madakkathara, the highest yield was obtained from M 15/4 (21.90 kg/tree). Highest plant girth and highest yield (6.976 kg/tree) was obtained in M 15/4 at Vridhachalam.

6. A total of 112 hybrids nuts were obtained from the crossing programme carried out at Bapatla. A maximum yield of 10.2 kg/tree was obtained for hybrid 4/1. At Bhubaneswar, eight different cross combinations were made and 149 hybrid nuts were obtained. Highest yield was obtained for Bhubaneswar C-1 x VTH 711/4 (0.750 kg/tree). During the year 22 different crosses were made and 74 hybrid nuts were obtained at Chintamani. Among the 56 hybrids planted in 1993 highest yield was obtained from V-5 x H 1591 (2.9 kg/tree) at Madakkathara and nine hybrids were field planted in 2000 for further evaluation. During the year 14 different cross combinations were undertaken and 1051 hybrid seeds were obtained at Vengurle. H 641 performed better than other hybrids in terms of yield (5.99 kg/tree). At Vridhachalam, the combination M 10/4 x M 26/1 produced the highest yield of 4.8 kg/tree.
7. Highest yield under NPK trial was obtained for N2P1K1 (3.50 kg/tree) at Bapatla. At Jhargram, the combination N2P2K2 resulted in maximum yield (5.47 kg/tree). At Madakkathara, the application of N1P0K1 resulted in maximum yield (10.21 kg/tree) in interaction trial. The N3P3K3 interaction trial (4.25 kg/tree) at Vengurle was significantly superior over other treatments in NPK interaction. Fertilizer application in high-density cashew plantations was initiated in all the centres.
8. Under spacing trial, maximum yield per block (47.08 kg/block) was noted in 6x6x6 m triangular system of planting at Jhargram Centre. The yield in treatment of 5x5m square (393.40 kg/block), 5x5m square with thinning (418.00 kg/block) and 5x5m square with 75% thinning (430.30 kg/block) were on par with each other and were significantly superior over the rest of treatments at Vengurle.
9. Intercropping trial indicated that during kharif season cluster bean was found to be most economical and during Rabi black gram was found to be remunerative at Bapatla. At Bhubaneswar, Cashew intercropped with turmeric fetched highest returns. Growing of tuber crops in cashew plantations was not found to be economical during the year under Madakkathara conditions. At Vridhachalam, it was found that the groundnut is highly profitable as an intercrop in cashew plantation.
9. Planting of Chintamani-1 at



Chintamani and Vengurla-7 at Vengurle were done during the year for carrying out drip irrigation trial. 11. At Chintamani, trees received spray at flushing, flowering and fruiting stages, least incidence of TMB was recorded. However, the population of natural enemies was highest in untreated control (T-10) during all the stages. However, the yield was highest in T-5 (6.59 kg/tree). At Jagdalpur also, the maximum yield was recorded for the trees treated with treatment T-5 (6.0 kg/tree). The treatment T-5 was found to be more effective than the other treatments after III spray, but however, the results were not significant at Vengurle. Standard spray (T5) was found to be most effective treatment at Vridhachalam.

10. The standard spray was the most effective treatment compared to other treatments at Bhubaneswar. At Chintamani, highest yield of 6.25 kg/tree was recorded in treatment T5. At Jagdalpur ethofenprox 0.015% was found to be better than all other treatments. Standard treatment T1 was the most effective in controlling pests of cashew at Jhargram. Highest yield was reported from Madakkathara in treatment T5 (8.80 kg/tree). At Vengurle, spraying with chlorpyrifos was found to be effective in controlling TMB. Standard spray (T1) was found to be most effective at Vridhachalam.
11. At Bhubaneswar, the treatment mud slurry + carbaryl swabbing along with lindane soil application was found to be better. Swabbing of neem oil and soil application of Sevidol 8G 75g/tree was most effective prophylactic control tried in Jhargram. Neem oil 5% swabbing along with lindane 0.2% and Mud slurry + Carbaryl 0.2% at four intervals were found to be more effective in Madakkathara. At Vengurle, swabbing with neem oil 5% along with Sevidol 46 oil application was found to be promising. Swabbing coal tar thrice with the application of Lindane 0.2% was most effective treatment at Vridhachalam.
12. Under curative control trial, the treatment mud slurry + carbaryl swabbing with Sevidol application was found better recovery percentage than other treatments at Bhubaneswar. The percentage of recovery was higher in T2 even in middle stages of CSRB attack and also higher in comparison to T3. At Madakkathara, maximum percentage of recovery of infested trees was seen in T1 treatment where neem oil 5% swabbing + Lindane 0.2% was given in early and middle



stages of infestation. Swabbing with *Metarrhizium anisopliae* + 5% neem oil was also found to be equally effective. Swabbing Neem oil 5% with 2% Lindane soil application and swabbing neem oil 5% with *Metarrhizium anisopliae* during early stages was found to be effective in Vengurle. At Vridhachalam, extraction of grubs, swabbing of coal tar, soil application of Sevidol and *Metarrhizium anisopliae* in combination during the early stages of attack is found to be most effective.

13. Under prophylactic control of CSRB, at Bhubaneswar, the treatment mud slurry + carbaryl swabbing along with lindane soil application was found to be better. Swabbing of neem oil and soil application of Sevidol 8G 75g/tree was most effective prophylactic control tried in Jhargram. Neem oil 5% swabbing along with lindane 0.2% and Mud slurry + Carbaryl 0.2% at four intervals were found to be more effective in Madakkathara. At Vengurle, swabbing with neem oil 5% along with Sevidol 46 oil application was found to be promising. Swabbing coal tar thrice with the application of Lindane 0.2% (T5) was

most effective treatment at Vridhachalam.

14. Under curative control trial, the treatment mud slurry + carbaryl swabbing with Sevidol application was found better recovery percentage than other treatments at Bhubaneswar. The percentage of recovery was higher in T2 even in middle stages of CSRB attack and also higher in comparison to T3. At Madakkathara, maximum percentage of recovery of infested trees was seen in T1 treatment where neem oil 5% swabbing + Lindane 0.2% was given in early and middle stages of infestation. Swabbing with *Metarrhizium anisopliae* + 5% neem oil was also found to be equally effective. Swabbing Neem oil 5% with 2% Lindane soil application and swabbing neem oil 5% with *Metarrhizium anisopliae* during early stages was found to be effective in Vengurle. At Vridhachalam, extraction of grubs, swabbing of coal tar, soil application of Sevidol and *Metarrhizium anisopliae* in combination during the early stages of attack is found to be most effective.



(b) TRANSFER OF TECHNOLOGY EFFORTS

During the year, 22 demonstration plots have been laid down in farmers field with high density lay out. One cashew day and 15 training programmes were conducted by different AICRP centres and also the scientists have participated in various seminars conducted by different agencies. A total of 4,48,848 grafts were produced and distributed to different government and non-government agencies as well as farmers. The centre-wise production of grafts is given below.

Grafts produced:

CENTRE	Number of grafts produced
Bapatla	20,000
Bhubaneswar	42,000
Chintamani	25,000
Madakkathara	1,52,600
Pilicode	11,814
Vengurle	1,97,434
TOTAL	4,48,848

Bhubaneswar

Scientists of AICRP had participated in four extension-training programmes conducted by Orissa State Cashew Development Corporation and one training programme for progressive farmers of Khurda

dist. During the year, 10 demonstration plots have been laid down in farmers field with high density lay out implementing soil conservation measures.

Chintamani

During the year under report, the Centre has laid down two demonstration plots. One Cashew Day was conducted and two training programmes were also conducted for the benefit of cashew farmers.

Jhargram

The centre has organized one training programme under DCCD imparting information to 200 farmers and one separate training for 32 farmers on cashew graft production and protection measures.

Madakkathara

During the year, the Centre has conducted 8 training programmes involving participants from Govt. (87 officials), Non-Govt. and cashew growers(67 participants). Dr. (Mrs) Susannamma Kurien had delivered a Raidio Talks on Pest Control in Cashew. The Scientists of AICRP Cashew had participated in 19 various training and seminars conducted by different organizations in the State.



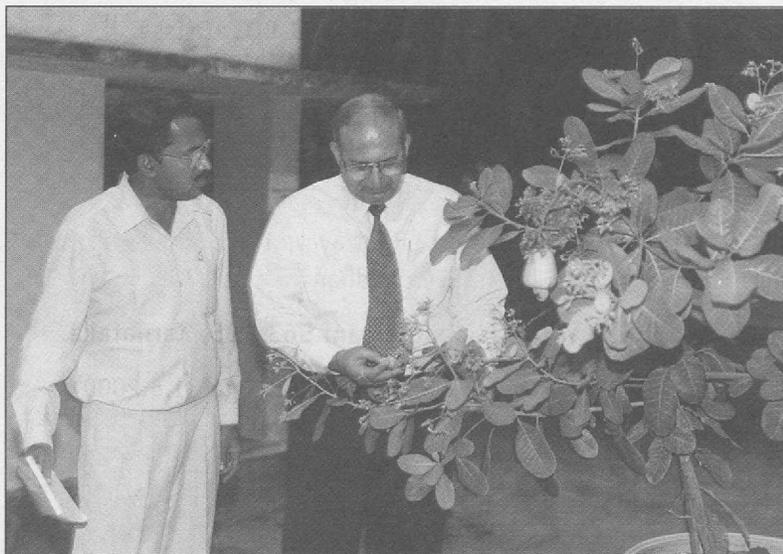
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Ten demonstration plots were laid out by the Centre in farmers field with the grafts of recommended varieties. Presently, the Centre is maintaining 26 demonstration plots. During the year, various training and seminars were organized for the benefit of farmers in scientific cashew cultivation. More than 1600 farmers and women participated in these trainings and seminars. In addition, the Scientist of the Centre participated in

five different workshops and symposia conducted by various scientific bodies. The Scientist had given two Radio Talks on Manuring Cashew Plantations and Control of TMB in Cashew (both in Malayalam) for the benefit of cashew farmers.

Vengurle

The Scientists of the Centre had given two Radio Talks during the year on High density planting in cashew and on Cashew Production Technology for the benefit of cashew farmers.



Dr. R.S. Paroda, Director General ICAR and Secretary DARE, during his visit to CRS, Madakkathara exchanges words with Dr. M. Abdul Salam, incharge CRS, Madakkathara on 01-02-2001