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Project Co-ordinator

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C O N T E N T S

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Cardamom

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Pepper

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CHAPTER I: TECHNICAL

i) CO-ORDINATOR'S REPORT

ii) EXPERIMENTAL RESULTS

CO-ORDINATOR'S REPORT

INTRODUCTION

The All India Coordinated Spices and Cashewnut Improvement Project started functioning in 1971 with the main coordinating centre and coordinating unit at Central Plantation Crops Research Institute, Kasaragod. The project covers nine crops and has at present 21 centres located at different agro-ecological regions where the crops covered under the project are grown. The primary mandate given to the project was to increase the production and productivity of the crops and the three main objectives are:

i) Evolving high yielding varieties resistant to disease and pests,
ii) Standardising agrotechniques for the crops under different agroclimatic conditions, and
iii) Evolving control measures for the major pests and diseases.

The project covers nine crops mainly cashew, pepper, cardamom, ginger, turmeric, cumin, coriander, fennel and fenugreek.

Brief summary of research results from different centres are presented experiment-wise in this report. Further details of experiments are available in the Progress Report of the individual centres.

The monsoon, during the period under report was generally active over the entire country and the total rains received at all the centres except Madakkathara (Kerala), Coimbatore (Tamil Nadu) were normal or slightly above normal. However, the distribution was rather unfavourable and continuous spell of dry weather adversely affected the growth and yield in cardamom and pepper. At Madakkathara under KAU, the rainfall was unusually low.

CO-ORDINATOR'S REPORT

The All India Coordinated Spices and Cashewnut Improvement Project covers nine crops namely Cashew, Cardamom, Pepper, Ginger, Turmeric, Cumin, Coriander, fennel and fenugreek and has 21 centres (including the Coordinator's cell at Kasaragod) located at different agro-ecological regions where the crops are grown.

The project envisaged coordinated research on the above crops with the main objective of

i) evolving high yielding varieties resistant/ tolerant to diseases and pests

ii) standardising agrotechniques for the crops under different agroclimatic conditions and

iii) evolving control measures for the major pests and diseases.

A brief report of the work done under the project is given discipline-wise under each crop.

CASHEW

Crop improvement

A total number of 794 collections of cashew germplasm are maintained and evaluated at different centres. Based on yield and quality characters, four selections and two hybrids from Bapatla (BPP No.3,4,5 and 6, and hybrids 2/11 and 2/12), (BPP 1 & 2) two selections (Vengurla-1 and 2) and two hybrids (Vengurla-3 and 4) from Vengurla and one selection from Vridhachalam (VRI-I) have been released by the respective state variety release committee, on the recommendation of the AICSCIP workshop. Three selections (BLA 139-1, BLA-273-1 and K-10-2) and two hybrids (H-3-19 and H-3-17) from Mannuthy are under pre-release multiplication. In the multilocational trials seedling progenies of four selections have recorded higher yield at all the centres with stability in yield over the years. The data on progeny performance, thus indicate that these lines could be used with advantage for production and distribution of clonal seed materials. Seven hybrids from Vridhachalam and seven from Mannuthy have recorded an yield of more than 10 kg per tree in the 8th year of their orchard life, and these are being evaluated further for stability in yield and quality factors.

Crop Management

The fertilizer experiment initiated at Vengurla in 1969 showed that the effect of nitrogen and phosphorus was highly significant. There was response to N up to N_3 level (125 kg/ha), i.e. 625 g/plant when P and K were also applied and response of P was up to P_2 level (250 g/plant) when N level was up to N_3. At other centres. viz., Vridhachalam, Bhubaneswar and Bapatla, there was response only for nitrogen and not for P and K. At Bapatla, where the soil is sandy, there was response to N up to N_2 level

(1000 g/plant) for all the characters studied. In yield both N_1 (500 g/tree) and N_2 (1000 g/tree) levels are found to be significantly superior to N_0, but there was no significant difference between N_1 and N_2 levels.

Foliar application of urea (3%) with endosulfan (0.05%) gave significantly higher yield under Vridhachalam conditions.

Vegetative propagation methods carried out at different centres show that side grafting, veneer grafting and epicotyl grafting are the most promising methods that could be adopted on a large scale. In addition, over 75% success in in situ budding is reported from Vittal and over 76% success in softwood grafting at Bhubaneswar.

Crop Production

Inflorescence blight of cashew caused by tea mosquito (Helopeltis antonii) can be effectively controlled by three rounds of spraying with endosulfan 0.05% at the emergence of new flushes, and later at flower emergence and at fruit set. A predator Endochus inornatus has also been recorded over Helopeltis. Experiments carried out at Vridhachalam using 10 insecticides against leaf thrips, it was observed that monocrotopos, quinalphos were superior to other insecticides in their efficacy to control leaf thrips.

CARDAMOM

Crop improvement

The germplasm collection at Mudigere comprises 26 types and 8 species of related genera and at Pampadumpara 18 types and 16 wilt related genera.

From the collections at Mudigere, three high yielding clones of prostrate type, viz., P1, P3 and P5 with an yield potential of 529, 830 and 614 g green capsules/clump, respectively have been identified for release as varieties. These clones have very high suckering potential also. In addition, 7 clonal selections from the early bearing types and 13 selections from the other clonal collections have been identified as promising. These selections have recorded more than 500g of green capsules/plant.

Among the F_1 progenies of diallel crosses, four cross combinations, viz., long panicle x early bearing, early bearing x leaf rot resistant, bold capsule x long panicle, and leaf rot resistant x bold capsule are found to be promising. One of the plants (No.731) under the cross combinations early bearing x long panicle has recorded 3 kg of green capsules successively for two years and the capsules are bold type with a green weight of 1.04 g as against 0.7 g normally produced by a typical prostrate plant.

At Pampadumpara, 7 erect types have been compared for yield potential and out of this type No.7, 17 and 107 were better yielders with good quality capsules.

Crop Management

The experiments conducted at Mudigere showed that cardamom crop removes 25.9 kg N, 4.35 kg P_2O_5, 52.11 kg K_2O, 13.95 kg Ca and 3.48 kg Mg/ha. The uptake of potash is significantly high being 12 times that of phosphorus and twice that of Nitrogen. The NPK fertilizer experiments conducted at Mudigere and Pampadumpara did not however, show any significant or consistent results. This may be due to (i) lack of uniformity in shade (ii) genotypic variations in the plant material used in the experiment.

Crop Protection

At Pampadumpara 5400 seedlings were screened against 'Katte' using viruliferus aphids @ 5 g/plant. None of the seedlings were found to be resistant to the disease. All the intergeneric crosses were screened against 'Katte'. disease.

Trials conducted at Pampadumpara show that Azhukal disease of cardamom could be reduced by drenching/spraying 0.03% Bayer 5072, Difolatan 0.3% or cuman 0.3%.

For the control of thrips, the insecticides fenthion, quinalphos, Phenthoate, fenitrothion and methyl parathion as sprays and phosolane as dusts were found to be effective.

PEPPER

Crop improvement

The earlier germplasm collections at Panniyur comprises 72 cultivars including an exotic type. During the period 1976-1978, 300 accessions were collected by a survey and during the year 1978-79, 117 wild and 5 cultivated accessions more were added to the germplasm. Among the cultivated types and hybrids, the hybrid Panniyur-I and seven other cultivars (Karimunda, Kottanadan, Kuthiravally, Balankotta, Cheriyakaniakadan, Kumbhakodi and Kalluvally) were found to be high yielders. Culture No.354, a highly promising type is under initial evaluation. In a comparative yield trial using Panniyur-I, Arakulam Munda, Balankotta, Kalluvally and Kuthiravally, Panniyur-I recorded the maximum yield of 1.2 kg/vine as against 0.084 to 0.952 kg in others.

Crop Management

The fertilizer experiment started in 1974 with three levels of N, 60, 120 and 180 g per standard per year, using Panniyur-I, showed that N_1 (60 g) level is significantly superior to N_2 (120 g) or N_3 (180 g) levels of N. Higher

levels of N was found to adversely affect the yield of pepper. Initial observations at Vellanikkara, indicated that growth and initial yield were better on dead standards and split application of fertilizers was found to be more beneficial than single application.

Crop Protection

Foot rot (quick wilt) is the major disease affecting black pepper inflicting upto 20% losses in some gardens. Phytophthora isolated from a severely affected garden at Badiadka was found to be more virulent than the one isolated from Maloth, and produce lesions on pepper leaf within 2 days of inoculation. Monthly isolation of Phytophthora from the soil collected from Badiadka during September using leaf as bait, was positive up to November. During the period under report, the incidence of quick wilt was very low (0.6%) at Bandadka. The survey covering 7 villages at Calicut district showed that the overall disease incidence was about 6.17%. The percentage incidence was found to be 6.35, 6.80 and 6.47 in Karimunda, Panniyur-I, and Arakulam Munda, respectively.

The control trial with Bordeaux mixture + fertilizer, Bordeaux mixture, Terrazole, Aliette, and Ridomil showed that there was no wilt incidence in plots treated with Bordeaux mixture + fertilizer, Bordeaux mixture and Ridomil. Soil samples analysed for copper content showed that the percentage of available copper was 0.3317, 0.1112 and 0.0043 in soil samples from plots treated with Bordeaux mixture in 1982, 1981 and control, respectively.

GINGER

Crop Improvement

The ginger germplasm collection comprises 100 types at Solan, 81 at Pottangi, and 38 at Kasaragod. At Solan accession Nos.645 and 564 were found to be promising recording an yield of 31,680 kg/ha and 30,800 kg/ha during the period under report. At Pottangi PG-2 (18,546 kg/ha) and PGS-35 (17,543 kg/ha) were the high yielders. Maximum recovery of dry ginger was recorded in PGS-19 (24%). Six accessions, viz., Wynad Local, Burdwan, Taffingiva, Nadia, Rio-de-Janeiro and Jamaica were found to be promising under the rainfed conditions at Kasaragod (yield 14-17 tonnes/ha). At Pottangi, mulching with green or dried leaves was found to yield better than intercropping with french bean or red gram.

TURMERIC

Crop Improvement

The turmeric germplasm collections comprises 102 types at Kasaragod, 91 at Pottangi and 53 at Coimbatore. At Kasaragod, five selections (Cls No.IC, 2A, 3D, 15B and 21A) were found to be promising (33-35 tonnes/ha). The yield was comparatively poor during the period under report, most probably due to the late planting. The sp. Curcuma amada gave the maximum yield of 38,280 kg/ha followed by 23,980 kg/ha in Vondimitta. A total of 67 accessions were described using the proforma. Among the 91 entries evaluated at Pottangi, Cls 13 recorded the maximum yield of 19,800 kg/ha and in the preliminary yield trial PTS-13 recorded the maximum yield of 20,708 kg/ha. At Coimbatore, compared to other entries, the yield was very high. Accession No.5380-2-3 and 5307-1-1 recorded the maximum yield of 15.59 kg and 15.55 kg/2.5 m^2 bed. The percentage of recovery varied from 15.5 in Amsitapani Kothapetta to 25.5 in Clone No.5362-2-1 and 5303-1-1. The promising clone 5307-1-1 yielded an average of 11,812.5 kg dried produce per hectare.

Crop Management

The fertilizer experiments at Solan and Pottangi did not show any significant differences between different treatments. In other trial, mulching gave significantly higher yield than intercropping.

CORIANDER

Crop improvement

The germplasm collection of coriander comprises of 140 types at Guntur, 200 at Jobner, 134 at Coimbatore and 155 at Jagudan. These collections have been evaluated for their yield and associated characters, including their reaction to diseases. Based on the results of initial evaluation and multilocation trials promising types have been identified. Among these, UD-41, a small seeded selection from Jobner with an yield potential of 11-14 q/ha has been recommended for release as varieties for Rajasthan by State Varietal Release Committee. UD-41 is a small seeded type developed through recurrent selection based on progeny testing from local collection. It is an erect type with a duration of 140-146 days. Essential oil content is 0.25% and comparatively more tolerant to wilt disease. Selection Ac.No.27 from Coimbatore (TNAU) is better than the existing variety Co.1 in yield as well as in quality, and has been released as variety Co.2 by Tamil Nadu Variety Release Committee. Other high yielding selections in the advanced stages of evaluation, are UD-20 UD-21 from Jobner, CS-2, CS-4, CS-5, CS-6 and P-2 from Guntur and GAU-1 from Gujarat.

Crop Management

Fertiliser trials conducted at different centres showed significant difference between the levels of Nitrogen applied. Fertilizer trial at Jobner (Rajasthan) and Jagedan (Gujarat) showed significant increase in yield

due to the application of nitrogen at 60 kg/ha. At Guntur, difference in yield due to increase in N level or application of FYM was not significant. However, the interaction of these main factors influenced the yield significantly.

CUMIN

Crop Improvement

Cumin germplasm collection comprises of 55 entries at Jagudan and 53 entries at Jobner. Based on the results of initial evaluation and multilocational trials, the selection Vijapur-5 has been recommended for release by the Gujarat Varietal Release Committee. In the multilocational trial conducted by the Gujarat state department of Agriculture for the last four years also showed that the yield of this selection is significantly higher. The average yield was 4.65 q/ha which is 59% higher than the local check S-407. It matures in 108 days. The variety has bold grains and an essential oil content of 3.3%. It has better tolerance to wilt as well as blight as compared to the previously released variety S-407 and M-43.

UC-198 is a promising selection from Jobner. It is an exotic type introduced from Egypt and has very high tolerance to cumin wilt in the field as well as under pot culture conditions. It contains 5% volatile oil as against 3% in the indigenous variety of cumin, and matures in 125 days. Because of its very high tolerance for wilt, it has been recommended for large scale trial in Gujarat and Rajasthan. UC-19 is another selection from Jobner at the advance stage of evaluation. It is better than the earlier variety RS-1 in yield as well as tolerance to wilt.

FENUGREEK

Crop Improvement

In fenugreek germplasm collections are maintained and evaluated at Guntur (40) Jobner (36), Coimbatore (26) and Jagudan (54). The selection NLM is a high yielding selection from Jobner developed through pure line selection.

The performance of this bold seeded selection is reported to be good outside state as well. This was recommended for release as variety (PRABHA) by the Rajasthan State Varietal Release Committee. UM-5, UM-17, UM-112 and UM-34 are the other promising selections at Jobner. Among the 26 accessions evaluated at Coimbatore, Acc.No.390 recorded the highest yield followed by Ac.No.913, 947 and 980. At Guntur, Lam Sel.I recorded the highest yield in the comparative yield trial.

FENNEL

Crop Improvement

In Fennel 189 accessions at Jagudan, 112 at Jobner, and 14 at Guntur are being maintained and evaluated. UF-31 and UF-32 from Jobner, PF-35 and S-7-9 from Jagudan and Lam Sel.I and Lam Sel.II from Guntur are the promising selections.

Crop Management

In the fertilizer trial at Jagudan, four levels of N_2 (0, 15, 30 and 45 kg/ha) and three levels of P_2O_5 (0, 15 and 30 kg/ha) were compared with eight more treatments, viz.,

i) N_0P_0 + Water spray
ii) N_0P_0 + Zn
iii) N_0P_0 + B
iv) N_0P_0 + Zn + B
v) $N_{15}P_{15}$ + Zn + B
vi) $N_{45}P_{30}$ + Zn + B
vii) $N_{90}P_{60}$ + Zn + B
viii) $N_{90}P_{60}$

adopting an RBD design with three replications.

Pooled analysis of the data for three years 1979-80 to 1981-82 show that the yield differences were significant and treatment combination $N_{45}P_{30}$ + Zn + B has given the highest average yield (1040 kg/ha) which was 65-87% higher than the control. The result further showed that the treatments $N_{45}P_{30}$ + Zn + B with a net increment benefit ratio of 1:5 could be more beneficial to get maximum yield.

EXPERIMENTAL RESULTS

CASHEW

Crop Improvement

Experiment 1. Germplasm collection and description of types and varieties.

(Mannuthy, Bapatla, Vengurla, Vittal, Vridhachalam and Bhubaneswar)

The germplasm collections maintained at different centres under the AICSCIP comprises 93 accessions at Madakkathara 179 at Bapatla; 177 at Vridhachalam; 138 at Vengurla; 163 at Vittal and 47 at Bhubaneswar. These accessions were evaluated for yield and associated characters. Substantial variability exists among these accessions for different characters like percentage of perfect flowers, fruitset per panicle, shape, colour and juice content of apple, yield of nut, nut size, shelling percentage, breakage percentage, aroma of leaves etc. Based on yield and quality of nuts, promising types have been identified from each of the centres for direct propagation as well as for utilising these as parents in the breeding programme. Important characters of selections identified at each of the centres are given below.

Table 1. Performance of promising cashew selections at different centres.

Name of the Centre	Selection No.	Age of the tree	Yield of nuts	Wt. of 100 nuts	Shelling %	Remarks
Madakkathara/ Anakkayam(KAU)	BLA-139-1	19	32.40	600	27.99	
	BLA-273-1	19	18.42	630	28.33	
	K-10-2	18	18.78	850	26.96	
	K-28-2	19	13.99	630	26.80	
	K-19-1	18	20.98	780	24.90	

	NLR-2-1	18	20.74	550	26.08	
	K-10-1	18	16.77	862	26.14	
	K-25-2	19	17.20	560	25.78	
	NDR-2-1	16	17.14	725	26.19	
			(Av.of 5 yrs.)			
Bapatla	3/3 Simha	25	13.0	630	28.1	Released as BPP-3
	9/8 Epurupalem	25	12.5	600	28.0	Released as BPP-4
	Tree No.1	50	42.1	524	26.7	Released as BPP-5
	Tree No.39	50	29.0	740	23.7	
	Tree No.40	50	18.1	-	27.7	
	Tree No.56	50	20.5	550	26.7	Released as BPP-6
	Tree No.129	50	40.6	-	-	
	Tree No.256	50	24.3	-	21.7	
	Tree No.273	50	28.4	550	25.5	
Vengurla	Vengurla-1	22	20.20	625	31	Released as Vengurla-I
	Vengurla-2	23	28.68	435	33	Released as Vengurla-II
	Veture-56	25	8.01	1100	25	
	Ansur Early	25	7.65	345	30	
	Mysore Kotekar 1/61	25	12.53	313	30	
	Midnapur red	23	2.58	455	32	
	Vengurla 36/3	23	10.56	400	31	
			Av.yield for the last 3 yrs. (1980-82)			
Vridhachalam	M 10/4		12.78	500	26.0	Released as VRI-1
	M 26/2		22.5			
	E 2/3		18.6			

During the period under report four accessions of germplasm collection at Bapatla were released as varieties by the Andhra Pradesh Variety Release Committee.

Among the 432 trees in the germplasm collections at Vridhachalam, 371 trees only yielded during 1982. The accessions M 26/2 recorded the maximum yield of 22.580 kg followed by 18.60 kg in E.2/3. M 10/4 recorded 11.45 kg during the period under report.

Biometrical variations in different characters were recorded for the 47 collections in the germplasm planted in 1975 at Bhubaneswar (Table 2).

Table 2. Biometrical variations in different characters of cashew under germplasm collection at Bhubaneswar

Characters studied	Range of variation within these types
Height of plants	2.71 m (Office front layer) to 6.22 m (M-17/4)
Girth of the stem	0.51 m (Selection 9/8) to 1.17 m (Tree No.125)
Canopy spread:	
i) North-south direction	4.05 m (K-28-2) to 8.46 m (Tree No.121)
ii) East-west direction	3.74 m (K-28-2) to 9.05 m (BLA-273)
Highest yield/plant	1.56 kg (Kerala seedlings) to 8.89 kg (M-26/4)
Average yield/plant	0.83 kg (Kerala seedling) to 5.83 kg (M-16/3)
Highest number of nuts/ plant	332 Nos. (Kerala seedlings) to 1875 Nos. (M-16/3)
Average number of nuts/ plant	21 Nos. (Kerala seedlings) to 1175 Nos. (M-26/2)

The yield data for the past four years showed that the accessions M 26/4 and M 16/3 (Vridhachalam types) recorded maximum yield for all the four years. During the year 1981-82, the highest yield of 8.89 kg/tree was recorded in M-26/4 followed by 8.56 kg in M 16/3.

One hundred sixty three accessions at CPCRI Regional Station at Vittal and 154 accessions at Shantigodu are being maintained and evaluated. The variability in apple and nut characters were studied and the mean values are given in Table 3.

Table 3. Variability in apple and nut characters among the various germplasm accessions at Vittal.

Traits	Mean	SE	CV %
Apple/nut ratio	7.29	0.19	37.3
Juice content	59.90%	0.51	12.3
Vitamin C	228.27 mg/g	0.41	25.4
Tannins	0.082 mg/g	0.042	72.0
TSS	18.72%	0.55	41.6

Germplasm collections planted at Madakkathara during 1976 were evaluated for their growth characters, flowering habit, yield and quality of nuts. Tree No.2052 (Adhoor 26-2) Tree No.1998 (Adhoor-6-1) and Tree No.2011 (Muliyar 25-2) were the high yielders during the period under report recording 8.95 and 7.15 kg respectively.

Table 4. Performance of seedling progenies of the cashew selections in comparative yield trial at different centres (yield of nuts - kg/tree)

Selection	Mannuthy		Bapatla		Vridhachalam		Vengurla		Bhubaneswar		Vittal		General Mean
	1982	1978-82	1982	1978-82	1982	1978-82	1982	1978-82	1982	1978-82	1982	1978-82	1978-1982
Vengurla													
Ansur-1	3.03	1.98	3.80	3.11	1.86	1.81	2.92	3.91	5.26	3.86	2.83	1.38	2.68
Vengurla 36/3	3.45	2.71	3.30	1.67	2.39	1.92	4.13	4.16	6.89	4.63	3.20 (Vet.56)	1.86	2.83
Vengurla 37/3	2.23	2.17	4.76	2.35	2.49	2.47	4.50	4.58	4.46	3.40	3.71	2.41	2.90
Savantwadi	3.83	2.86	5.86	2.70	1.01	0.97	2.66	3.53	3.75	2.72	5.33 (M-1)	3.62	2.73
Bapatla													
Tree No.1	3.28	2.26	6.40	4.62	2.59	2.89	4.15	3.93	4.08	3.52	4.85	2.73	3.33
Tree No.40	2.14	2.02	7.16	3.67	2.66	3.11	3.72	4.21	6.41	4.95	3.07	1.92	3.31
Tree No.56	3.43	1.90	5.70	3.93	2.50	2.59	4.94	4.95	5.02	4.01	3.17	2.06	3.24
Tree No.273	2.49	2.31	5.63	3.17	3.13	2.92	2.96	3.78	4.40	3.42	3.07	1.94	2.92
Vridhachalam													
M 10/4	2.62	2.21	5.76	3.55	2.22	2.42	4.66	6.20	7.61	4.43	6.15	3.74	3.76
M 6/1	4.10	3.27	5.43	3.05	3.06	2.96	4.64	5.07	5.26	4.24	4.25	2.53	3.52
M 44/3	4.36	3.45	7.33	3.73	4.86	4.02	7.48	7.18	8.90	5.16	6.01	3.56	4.52
M 76/1	-	-	6.70	3.25	3.65	3.51	3.78	4.43	5.14	4.06	4.32	2.63	2.76
Anakkayam													
K-10-2	5.59	3.45	4.40	2.41	1.84	1.44	4.99	5.05	5.01	3.56	2.74	1.42	2.89
H-4-7	5.50	3.02	3.10	1.99	2.11	2.04	3.70 (H-3-17)	4.58	3.90	2.85	3.09 (H-3-19)	1.87	2.73
BLA-139-1	5.65	2.81	6.86	3.19	2.96	4.19	4.51	6.14	2.57	2.73	5.25	2.70	3.63
BLA-256-1	2.13	2.11	3.36	2.30	2.72	2.56	4.18	4.72	5.97	3.51	3.93	2.29	2.92
K-27-1	4.51	4.37											
Mean	3.65	2.68	5.35	3.04	2.63	2.61	4.25	4.78	5.29	3.82	4.06	2.42	-

Experiment 3. Comparative yield trial with existing high yielders in different agroclimatic regions.

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

A comparative yield trial with seedling progenies of sixteen high yielding selections was started during 1973-74 at five centres namely Bapatla, Vridhachalam, Madakkathara, Vittal and Vengurla and in 1975 at Bhubaneswar. During the period under report also, the maximum average yield of 6.01 kg per tree was recorded in the progenies of M 44/3 which is on par with 5.05 kg/tree recorded in the progeny BLA 139-1. In all the centres the above two selections recorded more than the block average. The progeny means at each of the centres are given in table 4. A comparison of the mean yield of the progeny at each of the centres show that, under average level of management, there is a progressive increase in yield upto the 5th year of orchard life. The rate of yearly increase in yield gets gradually reduced and is almost negligible after the 8th year of orchard life except in sandy soils.

This trial was started during 73-74 and the plants can now be considered to have stabilised in yield. A critical evaluation of individual progeny for yield and quality of nuts and the possibility of utilising the promising lines for production of clonal seeds could be examined.

Another yield trial with six cashew cultivars namely type Nos.662, 657, 1140, BLA 139-1, TN-1, and TN-119 was started at the Horticultural Farm, Jhagram in West Bengal in the year 1978, adopting a randomised block design with 8 replications. Detailed observations were recorded on flowering, fruiting, apple and nut characters and yield.

Under West Bengal conditions seedling progenies of BLA-139-1 was found to be late flowering and No.662 early flowering. TN-1 recorded the shortest flowering phase,

maximum number of panicle per plant, highest number of nuts per panicle (4.5) highest yield per plant (1.61 k, and highest nut weight (6.5 g). Thus T.N.1 recorded the highest values for all the economic characters.

In the comparative yield trial planted at Madakkathara in 1975 with airlayers of 16 high yielding trees, NDR 2-1 recorded maximum yield of 7.358 kg/tree. H-3-17 which recorded maximum yield of 8.693 kg during 1981 yielded 4.471 kg during the year under report. Tree No. 1687 recorded the highest yield of 18.80 kg followed by 16.65 kg in Tree No.1792 under NDR 2-1.

Experiment 4. Hybridisation and selection
(Madakkathara, Bapatla, Vengurla and Vridhachalam)

At Madakkathara, a total of 283 hybrid progenies including 199 progenies brought from Anakkayam, were planted in 1973. Seven of these promising hybrids are being evaluated for the quality of nut and apple.

Among the 86 hybrids of the age group of 25 years at Bapatla, 8 trees recorded more than 15 kg nuts/tree. During the period under report, 730 crosses were made involving eight parental combinations.

Out of the 153 F1 progenies planted in 1973 at Vridhachalam, 122 recorded less than 3 kg, 14 recorded between 3 and 5 kg and 5 progenies recorded above 5 kg nuts/tree. Twelve progenies failed to yield during the year under report. The progeny M 26/1 x M 3/3-17 gave the maximum yield of 8.650 kg. Yield data for the past four years showed that among the F1 hybrids, nine progenies were promising. Yield data for the promising hybrids for the last two years are given in Table 5.

Table 5. Yield of promising hybrids at Vridhachalam (Planted in 1973)

Cross combination	Tree No.	Yield (kg/tree)	
		1981-82	Average for the last 5 years
M 33/3 Selfed	3	2.67	15.86
M 26/1 x M 3/3	17	8.65	14.88
M 26/1 x M 3/3	5	2.65	12.39
M 33/3 Selfed	14	5.27	12.33
M 10/4 x M 26/1	4	1.47	9.90
M 26/1 x M 3/3	16	5.01	10.37
M 26/1 x M 3/3	2	2.56	9.42
M 33/3 x M 10/4	10	5.19	9.41
M 10/4 x M 26/1	2	4.02	9.12

Hybridization work was started at Vengurla in 1970 involving seven parental combinations. Out of the 16 progenies planted from the above cross combinations in 1970, eight progenies are found to be highly promising. The percentage of perfect flowers varied from 3 to 43 and fruitset varied from 3 to 10. Two progenies belonging to the cross combinations Ansur No.1 x Vetore-56 (Tree No.5) and Midnapur Red x Vetor-56 (Tree No.11) have been released as Vengurla-3 and Vengurla-4 by the state Variety Release Committee in October 1981.

The hybridisation work was continued further by using promising types like M-44/3, M 10/4 and Assam-8 and a total of 1318 F_1 progenies were planted till June, 1981. During the year 1982, 261 progenies were obtained from eleven cross combinations.

Hybrid progenies evolved at Madakkathara, Bapatla, Vengurla and Vridhachalam have recorded very high yield by the 8th year of their orchard life. These hybrids are to be studied in detail for their economic characters especially, the shelling percentage and size of the kernal and clonal progenies tested at different location for their adaptability and stability in yield.

Experiment 5. Propagation trial

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

Under Kerala conditions, the ideal periods for side grafting, veneer grafting and budding were found to be between June to September and in the case of epicotyl grafting between March to June. The percentage of initial establishment varied from 36 to 72 in the case of side grafting, 43-64 in veneer grafting, 72 to 80 in epicotyl grafting and 48 to 64 in budding. It was also noted that the initial vigour is not maintained in the later stages. Hence, the casualities are more in the vegetative propagated plants. Epicotyl grafting was found to be easier and less costly than the other methods. Hence during the year 1981-82, studies were mainly confined to epicotyl grafting. The results are given in Table 6.

Table 6. Success of epicotyl grafting during the year 1982 at Madakkathara.

Month	No. grafted	Establishment (%)
March	100	49
April	100	71
May	100	68
June	100	57

The main drawback in this method is the incidence of collar rot in the root stock seedlings.

In the trial to study the role of nine different growth regulators in promoting rooting and establishment of airlayers, the following indications were obtained. (1) higher concentrations have depressing effect on rooting, number of roots and length of roots (2) no difference could be noticed between different treatments or between treatments and control, and (3) dipping in cowdung slurry or cows urine does not contribute to any appreciable advantage for establishment.

At Vridhachalam, in situ budding using one year old seedlings of M 26/1 was continued. The trial was conducted from June 1981 to May 1982 using 25 seedlings every month. Maximum budtake of 75% was recorded in June followed by 59% in July. In September and October 20% and 36.8% budtake was recorded, but none in the remaining months.

At Bapatla veneer grafting and patch budding were continued during this year also. The data showed that maximum success (76-100%) in veneer grafting was obtained in November followed by July (70-92%). In Patch budding, August and July months gave the maximum percentage of success (79 and 69 respectively).

At Bhubaneswar soft wood grafting was continued and maximum success was obtained in October 1981 (65%) and June 1980 (76%). The results of soft wood grafting for the last three years are given in Table 7.

Table 7. Success in soft-wood grafting at Bhubaneswar (1980-1982)

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1980	-	-	-	-	-	76	59	32	26	56	12	-
1981	-	-	-	-	16	40	50	40	40	65	10	-
1982	35	25	-	-	-	-	-	-	-	-	-	-

The vegetative propagation trials were started at Vengurla as early as 1968-69. The work done on different methods is summarised below:

1. Airlayering

   1. Layers prepared from November to May produce more roots and 72% to 88% sufficiently rooted layers were available for separation from the mother trees.
   2. Layers prepared during rainy seasons (June-September) have shown better root formation, but have failed to survive in polybags.
   3. The maximum survival (64%) in polybags was observed when the layers were prepared in April.
   4. The field establishment was more (60-88%) when planted during the period from June to August.

2. Veneer grafting

   1. Results for three consecutive years showed that September was the most congenial period for veneer grafting. The success ranged from 71-86%.
   2. The effect of Root stock of three to eight months old on the success of grafting was tested. The data are presented in Table 8.

Table 8. Success in veneer grafting with root stocks of different age groups at Vengurla.

Age of root stock	Percentage of success
8	68.33 (56.28)
7	69.44 (57.22)
6	80.00 (64.69)
5	67.78 (55.68)
4	35.00 (36.06)
3	24.44 (28.91)
S.E.	2.81
C.D. 5%	7.79

(Figures in paranthesis indicate the arcsin transformation)

The percentage of success (80%) of the grafts prepared on six months old root stock was significantly superior and on par with seven months old root stock was significantly superior and on par with seven months old root stock.

3. Side-grafting

Side grafting was found successful during the period from June-September. The success ranged from 50 to 90%.

4. Patch budding

In patch budding 33 to 50% success was recorded during the period from July to October. Fresh trials to study the effect of age of root stock on the success in veneer grafting and epicotyl grafting and the best time for soft-wood grafting were started in 1981.

5. Epicotyl and soft wood grafting

In the trial to find out the effect of root-stock on the success in epicotyl grafting, 120 grafts were prepared with stocks of 10, 20 and 30 days. For soft-wood grafting about 4-6 months old root stock was used. The data on the success in epicotyl and soft grafting are presented in Table 9.

Table 9. Success in epicotyl and soft-wood grafting at Vengurla

Month	Percentage of success			
	Epicotyl grafting			Soft-wood grafting
	10 days	20 days	30 days	
July	5.00	0.83	0.00	-
August	0.83	11.60	0.83	-
September	40.00	12.05	16.60	80.0
October	30.80	10.83	0.00	68.0
November	6.66	2.50	0.83	80.0
December	20.00	14.16	1.66	20.0

1982	January	50.00	24.16	11.66	60.0
	February	56.60	30.00	28.33	92.0
	March	70.08	23.30	10.08	82.0
	April	69.00	10.08	20.08	94.0
	May	60.00	10.00	5.00	54.0
	June	65.00	16.60	41.70	60.0

In epicotyl grafting maximum success was obtained with 10 days old root stock during the period from February-June (56-70%). Maximum success in soft-wood grafting was obtained in April (94%) followed by February (92%) and March (82%).

Vineer grafting, epicotyl grafting and soft wood grafting are found to be successful at all the centres under controlled condition. These methods have to be taken now to the field and large scale in situ grafting should be taken up adopting soft wood grafting and veneer grafting methods. Low field establishment of grafts may be due to lack of proper management. There is an urgent need to standardise management practices for grafts, both for transplanted as well as in situ grafts, to ensure better field establishment.

Crop Management

Experiment 7. Fertilizer experiment

a. NPK trial in Cashew

(Madakkathara, Bapatla, Vengurla, Vridhachalam and Bhubaneswar, West Bengal)

At Madakkathara, 73 percent of the trees in the NPK fertilizer trial did not yield fruits during the year 1981-82.

Table 10. Response of cashew to NPK fertilizers at Bapatla (Yield kg/tree)

N levels (g/tree)	P levels (g/tree)				K levels (g/tree)		
	P_0	P_1 (200)	P_2 (400)	Mean	K_0	K_1 (500)	K_2 (1000)
N_0	4.28	4.29	2.90	3.83	3.44	3.47	4.57
N_1 (500)	4.26	5.33	5.49	5.03	6.07	4.00	5.01
N_2 (1000)	6.20	6.63	7.64	6.82	6.20	7.05	7.22
Mean	4.91	5.42	5.34		5.24	4.84	5.60
K_0	5.57	4.29	5.84		SE/plot .. 2.7190		
K_1	4.74	5.45	4.33		Gen.Mean .. 5.2249		
K_2	4.43	6.52	5.86		CV (%) .. 52.04		
					C.D. for N .. 1.85		

The NPK fertilizer experiment was started in the sandy soils of Bapatla in 1972 and the differential doses of fertilizers were given from 1977 onwards. Analysis of yield data for the year 1981-82 confirm the earlier results. There is response for N up to N_2 level (1000 g/tree)., Even though N_2 has given the higher yield/tree, the differences between N_1 (500 g/tree) and N_2 is not statistically significant. Yield data for the NPK trial are given in Table 10.

At Vridhachalam, unlike the previous report in 1979-80 the different treatments in the NPK fertilizer trial showed no significant effect on the crop.

The NPK fertilizer trial started at Vengurla in 1969 with the seedling progenies has been discontinued from 1982 onwards as per the decisions of the 5th Workshop meeting.

The new trial was laid out in July 1981 on a 3^3 confounded design with inarch grafts of the released variety Vengurla-2. The treatments are N (0, 300 and 600 g/tree), P_2O_5 (0, 200 and 400 g/tree) and K_2O (0, 300 and 600 g/tree).

The NPK fertilizer experiment at West Bengal was started during the year 1978 adopting a 3^3 factorial confounded design with 8 replications. Data were recorded on vegetative, flowering and yield characters. Maximum plant height, girth and spread were recorded in N_3 (200 g N/plant/year) treated plants. The number of leaders and lateral branches produced per plant showed significant increase due to the application of higher levels of N, P and K. The highest levels, i.e. $N_3P_3K_3$ (N-200 g/plant/year, P_2O_5 - 100 g/plant/year, K_2O-100 g/plant/year) recorded the maximum number of leaders and laterals per plant/year. Number of panicles/plant also increased by the application of nitrogen. Treatment with the highest level of nitrogen increased the panicle number by 21.5 per plant compared to that obtained with the lowest level of the nutrient. Similar trend of increase was observed

by treatment with phosphorus and potassium. Higher levels of nitrogen resulted in marked improvement in the production of nuts per panicle and the highest level recorded 36 per cent more nuts than the lowest level.

Treatment with higher doses of nitrogen showed significant improvement in yield/plant. The highest dose of N (200 g/plant/year) increased the weight of nuts by 150 per cent over the lowest dose of the nutrient. Phosphorus and potash were also found to be effective in increasing the yield/plant. The data on yield are given in Table 11.

Table 11. Response of nitrogen, phosphorus and potassium on the yield of cashew at West Bengal

N levels	Yield per plant(kg)	P levels	Yield per plant(kg)	K levels	Yield per plant(kg)
N_1	0.98	P_1	1.35	K_1	1.33
N_2	1.60	P_2	1.80	K_2	1.69
N_3	2.45	P_3	1.99	K_3	2.02
S. Em ±	0.089		0.089		0.089
C.D. at 5%	0.249		0.249		0.249

Interactions

N x P	P_1	P_2	P_3
N_1	0.81	0.92	1.24
N_2	1.26	1.75	1.82
N_3	1.98	2.76	2.64
S. Em ±		0.155	
C.D. at 5%		N.S.	

N x K	K_1	K_2	K_3
N_1	0.89	0.83	1.25
N_2	1.16	1.58	2.08
N_3	1.94	2.68	2.76
S. Em ±		0.155	
C.D. at 5%		N.S.	

P x K		K_1	K_2	K_3
P_1		1.05	1.27	1.73
P_2		1.27	2.04	2.12
P_3		1.67	1.79	2.24
S. Em ±			0.155	
C.D. at 5%			N.S.	

N x P x K		K_1	K_2	K_3
N_1	P_1	0.62	0.67	1.12
	P_2	0.77	0.80	1.20
	P_3	1.27	1.02	1.42
N_2	P_1	0.87	1.12	1.77
	P_2	1.22	1.80	2.22
	P_3	1.37	1.82	2.25
N_3	P_1	1.65	2.00	2.30
	P_2	1.82	3.50	2.90
	P_3	2.35	2.52	3.05
S. Em ±			0.269	
C.D. at 5%			N.S.	

Maximum yield of 3.5 kg was recorded in the combinations $N_3P_2K_2$. Individual nut weight also was found to increase with the increase in the level of nutrients, especially nitrogen level. The size of the nut (length as well as diameter) also was found to increase with the increase in the nutrient levels.

As per the decisions of the Vth Workshop another fertilizer experiment was started in 1981 adopting a 3^3 factorial confounded design with two replications.

The different levels of the nutrients are:

Nitrogen - 0, 300 and 600 g/plant/year
Phosphorus - 0, 200 and 400 g/plant/year
Potash - 0, 300 and 600 g/plant/year

The full dose of the nutrients are to be applied from the 4th year onwards.

Spacing trial in cashew

In order to find out the optimum plant population per unit area, a spacing trial with 12 treatments were started in 1982 adopting a randomised block design with 3 replication. The details of the experiment are given below.

	Plant population/ha
i) 5 x 5 m (square) with no thining	400
ii) 5 x 5 m (square) and thining of 50% plants after 6 years	400-200
iii) 5 x 5 m (square) and thining of 75% plants after 11 years	400-200-100
iv) 10x5 m (rectangular)	200
v) 10x5 m (rectangular) and thining of 50% plants	200-100
vi) 10x10m (square)	100
vii) 10x10x10m (triangular)	115
viii) 8 x 8 m (square)	156
ix) 8 x 8 x 8 m (triangular)	180
x) 6 x 6 x 6 m (triangular)	321
xi) 6 x 6 m (square)	278
xii) 5 x 5 m (square) and selective thining	400-200-100

Experiment 7b. Effect of foliar application of urea with pesticides in cashew.

(Bapatla and Vridhachalam)

The experiment was continued at Vridhachalam with five treatments. Application of 3% urea in combination with 0.05% Endosulfan thrice gave the highest increase in yield (6.407 kg/tree) over the pre-treatment yield of 1979 as against 3.494 kg/tree in the plot treated with insecticide alone and 3.428 kg in the control. The data thus confirm the earlier results.

Table 12. Effect of application of urea with endosulfan at Vridhachalam

Treatment	Increase over the pre-treatment yield wt. of nuts (kg/tree)	
	1980	1982
Control	0.010	3.428
Endosulfan (0.05%) - 2 sprays	0.770	3.487
" 3 sprays	0.860	3.494
+ urea 3% - 2 sprays	0.900	4.111
+ urea 3% 3 sprays	1.450	6.407
SE	0.198	0.451
CD (P = 0.05)	0.610	1.390

The increase in yield of nuts for every kg of N applied and the economics of the application of Urea + endosulfan are given in Table 13 and 14 respectively.

Table 13. Increase in yield of raw nuts (weight in kg) per kg of Nitrogen applied through foliage

Quantity of spray fluid/tree/spray		7.5 lit
For 3 sprays 7.5 x 3		22.5 lit
For 3% urea solution		30 g of urea in 1 lit. of water
For 22.5 lit		675 g of urea
675 g of urea		310 g of Nitrogen
Extra yield of nut obtained over control (6.407 - 3.428)	=	2.979 kg
For 310 g of N. increase in yield of nuts	=	2.979 kg
For 1000 g of N increase in yield	=	9.610 kg
Increase in yield of nuts per kg of Nitrogen	=	9.610 kg

Table 14. Economics of foliar application of urea with endosulfan

1. Cost of ingredients of spray fluid of 22.5 lit for 3 sprays @ 7.5 lit/spray	
675 g of Urea @ 30 g/lit @ Rs.2.35/kg	1.58
33.75 ml of Endosulfan @ 1.5 ml/lit @ Rs.82/lit.	2.77
Total cost of ingredients	Rs. 4.35

2. Labour cost for spraying

1 man and 1 woman can cover 40 trees in a day of 8 hours

1 Man @ Rs.7/-

1 Woman @ Rs.5/-

Total Rs.12/-

For 40 trees the cost of spraying works out to	Rs.12.00
For one tree/spray .....(0.30 p)	
For 3 sprays .....30 x 3	0.90.
Total cost of ingredients + spraying	5.25
Additional income from additional yield of 2.979 kg @ Rs.5/kg	14.90
Additional cost involved by the treatment	5.25
Net profit/tree	9.65
For 204 trees (1 ha.) the net profit	Rs.1,968.60

Experiment 22. Hormonal application to increase fruit set in Cashew

(Vridhachalam)

In the trial at Vridhachalam with nine treatments and control, it was noticed that two sprays of 2, 4-D 10 ppm, one at flowering and another at fruitset gave the maximum increase in yield of 4.217 kg/tree over the pre-treatment yield as against 0.660 kg/tree in the control. The data are given in Table 15. The results are in conformity with the previous ones.

Table 15. Hormonal trials on cashew at Vridhachalam

Treatment	Mean increase over pre-treatment yield	
	1979-80	1981-82
IAA 50 ppm	2.05	2.253
" 100 ppm	2.78	3.023
IBA 50 ppm	1.17	3.340
" 100 ppm	1.30	2.041

NAA 10 ppm	2.89	2.061
2, 4-D 5 ppm	2.39	3.321
" 10 ppm	4.68	4.217
Water spray	0.14	1.633
Control	0.04	0.660
SE	0.76	0.559
CD (P = 0.05)	2.27	1.660

Crop Production

Experiment 39. Chemical control of pests of cashew (Madakkathara, Bapatla, Vridhachalam)

Chemical control trials against tea mosquito have been started at Madakkathara, Bapatla and Vridhachalam in 1981-82, with a view to screening an effective chemical, other than endosulfan, against tea mosquito and other pests of cashew. The treatments included seven insecticides, viz., Endosulfan (0.05%), Monocrotophos (0.05%), BHC 50% W.P., Malathion (0.05%), Quinalphos (0.05%), Carbaryl (0.15%), Phosalone (0.05%) and control.

At Madakkathara, there was no significant differences between different treatments as far as damage to panicle is concerned. The maximum yield was recorded in the control plots.

During the period under report, tea mosquito attack was not noticed at Bapatla. Pre-treatment assessment of pest population of blossom webber (Macalla moncusalis), shoot tip and inflorescence caterpillar (Chelaria haligramma) and apple and nut borer (Nephopteryx sp.) was made in April 1982. Two insecticidal sprays were given at 25 days interval, the pest incidence was recorded at 10 days interval. There was no statistical difference between treatments.

At Vridhachalam 10 insecticides, viz., quainalphos. monocrotophos, Dimethoate, Formothion, Malathion, phosphamidon, phosalone, endosulfan, carbaryl and BHC were tried against leaf thrips, leaf miner, leaf webber, and fruit and nut borer.

The maximum reduction in the population of thrips after the first round of spray was observed in Monocrotophos 0.05% and Phosphamidon 0.05% (36.97%). However, these were statistically on par with endosulfan (25.21%) and Phosalone (23.52%), but were significantly superior to the other treatments. After the 3rd spray, all the treatment proved to be significantly superior over control. Monocrotophos and Dimethoate recorded the maximum reduction in the population of the thrips (36.69%).

For the control of leaf miner, no significant difference could be noticed between different treatments, even though all the treatments were found to be significantly superior over the control in reducing the pest population ranging from 20 to 22 per cent. So also no variation between different treatments was obtained in reducing the leaf webber infestation after the third round of spray. The maximum reduction in the nut borer was obtained in monocrotophos 0.05% (50.57% reduction) followed by carbaryl 0.05% (49.25%), quinalphos 0.05% (45.32%) and endosulfan 0.05% (44.79%). The maximum decrease in the incidence of fruit borer compared to control was noticed in the case of endosulfan 0.05% (30.77%) which was statistically on par with carbaryl (27.60%), monocrotophos (24.15%), Phosalone (23.67%), Phosphamidon (17.89%) and BHC (17.11%). These were significantly superior to the remaining treatments as well as control. Taking into consideration of the

final yield of nuts after the insecticidal sprayings, no significant difference was noticed between the treatments and the control.

Another trial was laid out to find out the efficacy of three systemic insecticides, viz., Monocrotophos, dimethoate and phosphamidon in controlling cashew stem borer by trunk injection. The number of live and dead stages of the pest was recorded after 10 days. It was observed that none of these insecticides was effective in destroying the pest completely.

Tea mosquito infestation was not recorded at Vridhachalam during the period under report.

At Vengurla a trial with seven insecticides was started against the incidence of tea mosquito during the year under report. However, the incidence of tea mosquito was very low and highly erratic. Hence no conclusive results could be ontained.

CARDAMOM

Crop Improvement

Experiment 9. Germplasm collection and description of types and varieties
(Mudigere and Pampadumpara)

In the germplasm block at Mudigere, 16 cultivars and eight species of related genera are being maintained in study rows. Twentynine cultivars and eleven species are being maintained at Pampadumpara.

Experiment 10. Comparative yield trial of promising types
(Mudigere and Pampadumpara)

During the year 1967, eighty seedlings which produced panicles in the nursery stage itself at Mudigere were isolated as early bearers and planted in a separate block in 1968. The performance of the selection for the past 10 years helped to identify seven promising selections with an yield potential ranging from 125 to 325 g of green capsules/plant under rainfed conditions.

Yield data for the 80 clonal selections for the last ten years showed that 13 selections have recorded more than 500 g of green capsules/clump/year, which worked out a minimum of 300 kg of dry capsules/ha. These selections have been planted in a replicated trial during the year 1981 for further studies.

Multilocational trial

A multilocational trial with seedling progenies of fifteen promising mother clumps was laid out during the year 1974 at Mudigere and Appangala. The cumulative yield data recorded at Mudigere, for the last four years, revealed that seedling progenies of CL-664, CL-730, CL-668 and AS-6/3 are promising.

The three clones P1, P3 and P5 were selected from the 25 clones under multilocational trial and planted in 1979. Observations were recorded on suckering habit, panicle production and yield. Even though there was no significant difference between the clones in respect of suckering habit and panicle production, yield was found to be significantly high in clone P1 and P3 than P5 and control. The data are presented in Table 17.

Table 17. Performance of the three promising selections under multilocational trial at Mudigere.

Selection	No. of suckers/ plant	No.of panicles/plant	Yield of green capsules/plant
P1	25.74	36.5	569.80
P3	24.76	35.3	441.61
P5	21.52	24.5	294.91
Control	22.68	29.1	218.75

The performance of the seedling progenies of these 25 selections showed that P1, P2, P14 and P16 were superior to others with regard to yield.

Sixteen clones yielding more than 500 g/plant were selected as promising after the evaluation of seedling and clonal material for the last 10 years, and laid out a new experiment in a balanced lattice design with six replications. The experiment started in September, 1981. The clones identified were CL-652, CL-654, CL-664, CL-668, CL-675, CL-679, CL-681, CL-683, CL-691, CL-726, CL-728, CL-729, CL-730, P1, P3 and P5.

At Pampadumpara, the experiment was closed as per the decisions of the Annual Technical Review Committee of Research Projects.

Experiment 11. Hybridization
(Mudigere and Pampadumpara)

The diallel crosses involving six characters and having 30 cross combinations were planted at Mudigere during 1974. The earlier indications were that the combinations involving early bearing type was comparatively better, eventhough the difference in yield between different combinations were statistically not significant. The performance of the diallel cross combinations are given in Table 18.

On the basis of four year's yield data, 60 plants were screened as promising. The average yield from these plants ranged from 603 to 2183 g green capsules per clump/year. One of the plants under the combinations early bearing x long panicle recorded 3 kg green capsules successively for two years. The capsules are bold weighing an average of 1.04 g as against 0.75 g normally produced by a prostrate type plant.

Crop Management

Experiment 12. Manurial Experiment
(Mudigere and Pampadumpara)

As the manurial experiment started at Mudigere and Pampadumpara did not show any significant or consistant results, it was decided to start fresh trials under uniform shade with monoclonal material. At Mudigere another trial with 9 combinations of Ca and Mg was laid out in 1981 to find out the significance of these two elements on cardamom crop.

Crop Protection

Experiment 25. Testing parental lines for disease resistance
(Pampadumpara)

As per the revised technical programme, large number of seedlings were raised and inoculation of seedlings with viruliferous aphids @ 25 per seedling is in progress.

Experiment 32. Studies on 'Azhukal' disease (Pampadumpara)

The Pathogen, Phytophthora was found to infect almost all shade trees, fruit plants and weeds found in and around the cardamom estates.

Field control trials against the disease for the last two years showed that the fungicide Bordeaux mixture 1% as spray or drench or both was the most effective method available at present for checking the disease. Four new trials have been contemplated. They are (i) Field trials to control Azhukal disease of cardamom in different tracts (2) Evaluation of fungicides against Phytophthora sp. causing Azhukal disease of cardamom in vitro. (3) Epidemiology of the Azhukal disease of cardamom (4) Etiolcgical studies of clump rot and Azhukal disease of cardamom.

Experiment 39. Chemical control of cardamom thrips (Pampadumpara, Yercaud)

It was observed that application of insecticides during August and September is inevitable for the proper control of cardamom thrips. Skipping of spraying insecticides during these months will adversely affect the quality of capsule.

At Cardamom Research Station, Yercaud, it was observed that wider spacing of 2.5 x 2.5 m significantly reduced the incidence of stem borer to 1.41 to 2.50 per cent as against 27 to 28% in 1 x 1 m spacing.

In order to find out the effect of hormone in reducing fruit drop in cardamom, a new experiment was laid out at Mudigere in 1981 with 9 treatments and a control. No significant difference was noticed between the different treatments or between treatments and control.

Table 18. Performance of the diallel crosses at Mudigere (Yield of green capsules/ plant (g) for the year 1981-82

Characters	Early bearing	High yield	Long panicle	Leaf rot resistant	Bold capsule	Multiple branching	Mean	Mean (1980-81)
Early bearing	383.9	569.8	351.4	385.8	165.1	405.7	376.9	635.0
High yield	205.7	379.3	175.3	361.9	313.8	348.1	297.3	660.0
Long panicle	531.7	246.4	312.0	124.7	346.0	289.2	308.3	505.0
Leaf rot resistant	463.3	390.5	244.3	230.4	174.1	322.2	304.1	568.0
Bold capsule	380.0	175.3	459.2	287.1	332.7	399.3	338.9	526.0
Multiple branching	383.1	401.3	400.0	364.9	355.7	219.6	354.1	641.0
Mean	391.3	360.4	323.7	292.5	281.2	330.7		
Mean (1980-81)	760.0	614.0	572.0	618.0	470.0	500.0		

Plot average: 330 g/plant.

PEPPER

Crop Improvement

Experiment 13. Germplasm collection and screening of pepper
(Panniyur)

Pepper germplasm assembage at Panniyur comprises 114 cultivated and 33 wild types which include four cultivated and seven wild types collected during the year under report.

Experiment 14. Intervarietal hybridisation
(Panniyur)

Five hundred hybrid and open pollinated seedlings were transplanted to the main field. From the 2000 seedlings in the nursery, 771 belonging to 23 combinations were selected for planting in the main field.

During the period under report 147 cultures were harvested. Based upon yield and associated characters, 87 cultures were selected for multiplication and further studies.

Hybridization involving 11 parental combinations were carried out during the period under report.

Experiment 15. Comparative yield trial
(Panniyur)

The comparative yield trial with four local popular varieties, viz., Arakulam Munda, Kalluvally, Balankotta and Kuthiravally along with hybrid Panniyur-I was planted in 1975. Panniyur-I hybrid continued to give higher yield, this year also followed by Kuthiravally. The total number of bearing plants is found to vary during each year and for each variety.

Crop Management

Experiment 17. Fertilizer experiment on pepper (Panniyur)

In order to find out the fertilizer requirement of pepper, two experiments were started at Panniyur during the year 1974-75, one with graded doses of nitrogen and lime, and another with all the three major nutrients N, P and K. The former one concluded during the year 1980 clearly drawing the conclusion that 60 g N/plant/year is sufficient for the hybrid pepper Panniyur-I. In the latter experiment, the combination 50 g N, 100 g P_2O_5 and 150 g K_2O recorded the maximum yield.

Crop Protection

Experiment 35. Quick wilt and slow wilt disease of pepper (Kasaragod and Panniyur)

At Kasaragod Phytophthora was isolated from pepper vines severely affected by quick wilt disease from a garden at Badiadka where pepper is grown on arecanut. There was heavy defoliation following severe

foliar infection. The sporangium was elongated with tappered base and measured 24-60/in length and 8.32/u in breadth and pedicel measured 32-160/u. It was more virulent than the Maloth isolate of Phytophthora. The pathogen produced lesions on pepper leaf within 2 days of inoculation while the Maloth isolate took more than 4 days for lesion production. The pathogen also infected colocasia and elephant foot yam growing in the affected garden.

At Panniyur, during the year under report, apart from Bordeaux mixture, ten other fungicides were evaluated in vitro by using poison food technique developed by Zentmyer (1955). The fungicides were tried at two concentrations of the medium, 1000 and 2000 ppm. Apart from Bordeaux mixture, seven other fungicides were found to inhibit fungal growth in the culture media. A field trial using the above fungicides have been started during the period under report.

A field control trial against slow wilt disease of pepper has also been started at Panniyur by using five chemicals.

Experiment 41. Control of Pollu disease of pepper (Panniyur)

Observations on the incidence of Colletotrichum on pepper leaves, spikes and berries showed that:-

i) Percentage of leaf infection was more on the eastern side and two metre height and minimum on the southern side.

ii) Out of the total spike shedding of 13.08%, shedding due to fungal infection was only 5.74%.

iii) Loss in weight of berries (reduction in yield) was very high due to thread infection followed by early infection.

iv) Infection by the fungus was noticed from the time of spiking onwards. However, the percentage of infection was more pronounced during August-November.

GINGER AND TURMERIC

Crop Improvement

Experiment 18. Germplasm collection and evaluation of ginger

(Solan, Kasaragod, Pottangi and Vellanikkara)

One hundred clones are maintained and multiplied at Solan. Of these 18 yielded more than 200 g/plant. Accession numbers 645 and 564 gave the maximum yield of 360 g (31,680 kg/ha) and 350 g (30,800 kg/ha) plant respectively.

In the initial evaluation trial at Solan with 22 accessions, maximum yield of 215 g/plant (18,920 kg/ha) was recorded in accession No.564 followed by 202 g (17,776 kg/ha) in 646. The clone 646 yielded 500 g/plant (44,000 kg) during the previous year also.

At Pottangi 81 accessions are maintained and evaluated. PGS-2 recorded maximum yield of 4.215 kg/1.5 M^2 (18546 kg/ha) followed by PGS-35 (3.987 kg/1.5 M^2 (17,547 kg/ha).

In the preliminary yield trial at Pottangi with 20 cultivars, Ernad Manjeri yielded 5.133 kg/3m2 bed (11,292 kg/ha) followed by PGS-19 (4.000 kg (8,800 kg/ha). Maximum recovery (24%) was recorded in PGS-19.

In the comparative yield trial with six cultivars Vengara selection recorded the maximum yield of 5.212 kg/3m2 followed by PGS-19 (4.862 kg/3m2). Vengara selection recorded higher yield during the year 1981 also.

The ginger germplasm collection consists of 38 accessions at Kasaragod. Yield data for the last four years showed that six cultivars, viz., Wynad local, Burdwan, Taffingiva, Nadia, Rio-de-Janeiro and Jamaica perform equally well under the rainfed conditions at Kasaragod (Yield 14-17 tonnes/ha). Fifteen accessions were described using the germplasm descriptor. In the comparative yield trial, the cultivars Wynad local, Burdwan and Nadua records significantly higher yield among the nine cultivars tested (yield 12.5-15 tonnes/ha).

At Vellanikkara, the scheme started functioning only in June, 1982.

Crop Management

Experiment 19. Manurial cum seed rate trial in ginger (Pottangi)

During the year 1981-82, two varieties, UP and Vengara selections were tried in three different planting methods and two different size of seed materials. No significant difference could be noticed either in the size of planting materials used or in the different methods of planting. This is in conformity with the previous years. Mulching with green or dry leaves was found to be superior to intercropping with french bean or red gram.

TURMERIC

Crop Management

Experiment 20. Germplasm collection and evaluation of turmeric

(Kasaragod, Solan, Pottangi and Coimbatore)

The germplasm collection of turmeric at Kasaragod comprised 102 types, of which 78 accessions comes under Curcuma longa, 21 under C. aromatica, 2 under the sp:

C. amada and one accession from Indonesia. Apart from these 63 clones selected from 38 longs types are also being maintained. Under the rainfed conditions at Kasaragod, five selections (Cls No.IC, 2A, 3D, 15B and 21A) were found to be highly promising (33-35 tonnes/ha). During the year under report the sp: Curcuma amada gave the maximum yield of 17.4 kg/bed of 3m x 1m (38,280 kg/ha followed by 10.9 kg (23,980 kg/ha) in Vondimitta, 10.6 kg (23,320 kg/ha) in Wynad Local, 10.4 kg (22,880 kg/ha) in Ethamukula and 10.4 kg (22,880 kg/ha) in No.24. Among the 63 clonal selections the high yielders were Cls No. 15B (10 kg - 22,00 kg/ha), 2A and 2-8.7 kg each 19,140 kg/ha) and 14 B (8.5 kg, 18,700 kg/ha). The comparative yield trial with five selections Cls No.IC, 2A, 3D, 15B and 21A) did not show any significant difference. A total of 67 accessions were described according to the proforma.

At Pottangi, 91 entries were evaluated, of which Cls No.13 recorded the maximum yield of 4.5 kg/1.5 m^2 bed (19,800 kg/ha) followed by 4.18 kg (18.392 kg/ha) in Karhadi local. In the preliminary yield trial, the highest yield was recorded by PTS-13 (9.413 kg/3m2 - 20,708 kg/ha) followed by 8.250 kg (18,150 kg/ha) in PTS-49, as against 9.50 kg/3m2 bed in PTS-62 during the previous year. Maximum recovery of dry turmeric was recorded in PTS-10 (2.376 kg/3m2 bed - 9,944 kg/ha) as against 7.050 kg/3m2 bed during last year.

At Coimbatore 53 selected accessions were studied for their biometrical traits. The range of various characters are given in Table 19.

Table 19. Biometrical traits of 53 selected accessions of turmeric at Coimbatore.

Character	Range/plant
1. No.of mother rhizomes	1.8 to 4.8
2. Weight of mother rhizomes	22 g to 114 g
3. No. of primary rhizomes	6.6 to 20.4
4. Weight of primary rhizomes	94 g to 275 g
5. No. of secondary rhizomes	17.0 to 47.8
6. Weight of secondary rhizomes	59 g to 169 g
7. Yield/plot (fresh rhizome)	2.93 kg to 15.59 kg

The highest yield of 15.59 kg/plot of 2 sq.m. was recorded in Acc.No.5380-2-3 followed by 15.55 in 5307-1-1. The percentage of recovery of dry turmeric varied from 15.5 to 25.5. Based on the recovery of dry turmeric, the promising entries screened were Acc.No.5377-1-1, 5363-3-4, 5303-1-1, 5303-1-1 (20 kr) and 5307-1-1. In the comparative yield trial with 19 promising cultivars also, the Acc.No.5307-1-1 recorded the highest yield of 96.9 kg/16M2 as against 42.9 kg in the local. The curing percentage ranged from 17 to 21.25, the maximum in 5303.33. The promising clone 5307-1-1 yielded an average of 11,812.5 kg dried produce per hectare.

Crop Management

Experiment 21: Fertilizer experiment in turmeric (Solan and Pottangi)

As in the previous years, the fertilizer experiment at Solan and Pottangi gave no significant differences among different treatments. The second trial at Pottangi with 15 combinations of three levels of manures and two levels of green leaves as mulch, also showed no significant differences between different treatments like the previous years. In the experiment to compare the effect of mulch

and intercropping in turmeric beds, it was observed that mulching gave significantly higher yield (up to 4.73 kg/3m² bed (10,406 kg/ha) as against 1.187 kg (2,611 kg/ha) in intercropping.

Crop Protection

Experiment 36. Rhizome rot of ginger and turmeric (Kasaragod)

In the comprehensive trial laid out at Calicut and Kasaragod comprising two fungicides two insecticides and three amendments, cowdung treated plots had the highest germination followed by neemcake treatment. Disease incidence was minimum in Pongamia cake treated plots. At Kasaragod, Pongamia, Metacid combination favoured the best crop stand. At Calicut, insecticide treated plots fared better than control, although between the insecticides there was no significant difference. Both oilcakes and and Difolatan had a depressing effect on total microbial count. Lifolatan treated plots receiving no insecticides had the best count. Isolation for fungi and insects yielded only fungi in the initial stages. Maggots and pupae appeared only later than fungi.

In storage, Pythium population was less in February (1%), increasing in May & June to 11% and 21% respectively. Fusarium count was 61% in February and increased up to 70% in June.

Efficacy of the various seed protectants was in the following order viz., Terrazole 0.2% (48% recovery), Bavistin 0.3% (46%) Aretan (43%) and Dithane M-45 (43%). On the different methods tried storing in paddy husk gave maximum recovery viz., 55.9% followed by Sand (51.1%), sawdust 49.8% and Glycosmis leaves 40%. When 100% visibly good rhizomes were stored, seed recovery was 60%. When 10% rotten rhizomes were mixed and stored, the recovery was only 18%.

The "date of sowing" trial was laid out at Peruvannamuzhi with eight sowing dates stretching from February to forming the main plots and 3 fungicidal treatments forming the sub plots. First fortnight of May through first fortnight of June were the most favourable sowing period, followed by last quarter of April. Difolatan seed treatment was found to be superior or DM-45.

In an experiment conducted to study the combined effect of activated charcoal and fungicides, Dithane M-45 when combined with activated charcoal afforded better post emergence protection 198% than Difolatan. When calcium oxide was dusted on the cut ends of the seed rhizome, post emergence stand was improved (98%) considerably over control. (87%)(42°C). In a trial to study the efficacy of hot water treatment and cowdung slurry followed by smoke treatment independently and in combination on seed rhizomes, hot water alone was as efficient (89%) as the combined treatment. Rogueing had a distinct advantage in improving crop stand (74%) over the control (56%). In a trial where varying concentration of Aza uracil (0, 1, 10 & 100 ppm) were tried as seed treatment, the 10 ppm concentration alone supported crop growth (96%) better over control.

CORIANDER

Crop Improvement

Experiment 42. Germplasm collection, maintenance and selection

(Jobner, Jagudan (Vijapur), Guntur and Coimbatore)

The coriander germplasm collection at present comprises 140 types at Guntur, 200 at Jobner, 134 at Coimbatore and 155 at Vijapur.

At Guntur, 140 entries were evaluated on the basis of biometrical analysis of variations. Seven entries recorded more than 12 q/ha (variation 12-14 q/ha) whereas 34 recorded 10-12 q/ha. The duration of most of the entries was 91-100 days. The variations in different vegetative and yield characters are given in Table 20. The maximum yield of 1 .96 q/ha was recorded in AS-97.

Table 20. Biometrical variation in coriander types evaluated under germplasm at Guntur.

Sl. No.	Character	Range	G.M.	Class Interval	No. of lines
1	2	3	4	5	6
1.	Plant height (cm)	41-74	54	40-50	41
				51-60	86
				61-70	12
				71-80	1
2.	No. of primary branches	4-14	7	1-5	23
				6-10	113
				11-15	3
3.	No. of secondary branches	5-25	11	1-5	3
				6-10	64
				11-15	52
				16-20	19
				21-25	2

4. Days	50% flowering	48-50	56	45-50 9 51-55 37 56-60 94
5. Total	uration in days	86-106	99	80-90 1 91-100 119 101-110 20
6. No.	ıbels/plant	5-29	13	5-10 51 11-20 75 21-30 14
7. No. of	mbellets/umbel	4-8	6	1-5 71 6-10 69
8. No. of	mericarps/umbel	7-38	16	1-10 26 11-20 91 21-30 21 31-40 2
9. No. of	mericarps/plant	60-350	151	50-100 32 101-150 60 151-200 28 201-250 11 251-300 6 301-350 3
10. Yield	in kg/ha	417-1396	880	400-600 14 601-800 37 801-1000 48 1001-1200 34 1201-1400 7

Evaluation of 200 entries at Jobner showed high variation between entries in yield and associated characters. The yield/ha ranged from 3 to 11 q/ha with a c.v. of 31.42%. Variation in biometrical characters are given in Table 21. Maximum yield of 11.45 q/ha was recorded in UD-373. The UD-41 gave only 7.64 q/ha. In general the performance of all the entries was poor. Only UD-3 3 yielded more than 10 q/ha. The volatile oil content varied from 0.062 to 0.250 percent, the maximum recorded in UD-71 (0.250%).

Table 21. Biometrical variation in coriander germplasm collection evaluated at Jobner.

Characters	Range	G.Mean	S.E.	C.V.(%)
Days to flowering	64.75-115.25	79.25	10.80	13.62
Days to maturity	122.00-143.00	129.42	5.61	4.33
Plant Height (cm)	35.90-82.30	53.99	11.67	21.62
Branches/plant	4.45-6.25	5.53	0.47	8.55
Umbels/plant	12.65-40.10	24.44	5.80	23.73
Umbellets/plant	51.60-145.10	84.85	26.16	30.83
Grains/umbel	3.60-6.18	4.80	0.70	14.64
1000 grains weight(gm)	6.20-16.50	11.39	2.46	21.56
Yield q/ha	3.28-11.45	6.13	1.93	31.42
Volatile oil content(%)	0.062-0.250	0.14	0.05	31.83
Blight	0-3.00	1.71	0.88	51.37
Powdery mildew	0-5.00	3.29	1.58	48.02

At Coimbatore 134 entries were evaluated and wide variations were recorded for different characters studied. The biometrical variations for various characters are given in Table 21. Culture-270 (from P2) gave the highest yield of 295 g/row of 30 m long. Other promising accessions were AC No.735 (239 g/row) and Ac.No.695 (287 g/row).

Table 22. Biometrical variation in coriander types at Coimbatore

Characters	Range	G.Mean	S.E.	C.V.(%)
Yield of seed/plot	15.00-295.00	150.02	65.83	43.89
Height of plant(cm)	19.64-56.84	33.51	6.39	19.06
No.of primary branches	2.80-3.80	5.70	1.16	20.35
No.of secondary branches	10.60-23.80	17.16	2.11	12.29
No. of umbels	20.00-38.80	29.29	3.77	12.87
Umbellets/umbel	3.70-6.60	5.45	0.64	11.78
Weight of seed/ 5 plants	9.00-27.00	16.07	3.42	21.30
1000 seed weight	12.20-18.80	14.84	1.05	7.10

Experiment 43. Varietal trial in coriander (Guntur, Coimbatore and Jobner)

The fourteen varieties were evaluated at Guntur. Selections CS-2, CS-4 and P2 were the high yielders for the past three years, whereas AS-18, a selection from Anantapur gave the maximum yield of 1195 kg/ha during the period under report followed by P-4 (1125 kg/ha) and CS-4 (1104 kg/ha). The yield data for the past four years are given in Table 23.

Table 23. Yield data for the promising coriander strains at Guntur under initial evaluation (Yield (kg/ha)

Strains	1978-79	1979-80	1980-81	1981-82	Mean
CS-2	1224.62	1014.88	833.00	1063.0	1033.9
CS-4	1209-75	982.15	826.00	1104.0	1030.5
P2	1037.14	970.24	806.00	992.0	951.4
AS-18	-	-	583.00	1195.0	889.0
P-4	-	-	757.00	1125.0	941.0
Mean	1157.17	989.09	761.0	1096.0	-

When the yield data for the past four years were compared it was observed that CS-2 and CS-4 were the promising strains among the fourteen under initial evaluation.

At Jobner, the trial was conducted at Aklera and Durgapura in addition to Jobner. At Durgapura, the crop was destroyed by storm, hence the yield data could not be recorded. At Aklera, GAU-1 only gave an yield equal to the check (13.65 q/ha), the yields from all others were low. At Jobner, the highest yield was obtained from UD-373 (9.97 q/ha) followed by UD-41 (8.60 q/ha). The yield data for different varieties are given in Table 24.

Table 24. Varietal evaluation of coriander at Jobner and Aklera

(Yield q/ha)

Variety	Aklera	Jobner	Mean
UD-1	10.05	5.93	7.99
UD-20	9.10	6.69	7.89
UD-21	13.60	7.44	10.52
UD-41	8.10	8.60	8.35
UD-373	8.30	9.97	9.14
UD-374	6.85	7.28	7.07
CS-4	8.75	4.38	6.57
GAU-1	13.65	4.56	9.11
Local check	13.65	8.49	11.07
SE	1.05	0.37	
CD at 5%	3.05	1.04	
CV (%)	21.07	11.83	

At Coimbatore, the varietal evaluation trial was merged with the comparative yield trial.

Experiment 44. Yield trial in coriander
(Coimbatore, Guntur, Jobner and Jagudan)

The trial was initiated at Guntur in 1975-76 with 28 accessions, at Jobner and Jagudan with 16 accessions and at Coimbatore with 12 accessions. A comparison of different accessions at different centres are given in Table 25. At Guntur, the performance of all the accessions was good compared to other centres. Seventeen accessions recorded more yield than the block average of 1149 kg/ha. The high yielders of the previous years, CS-4, CS-2 and P2 gave the maximum yield during 1981-82 crop season also. The yield data for the promising accessions for the last four years are given in Table 26.

Table 26. Performance of the high yielders under yield trial at Guntur (Yield kg/ha)

Variety	1978-79	1979-80	1980-81	1981-82	Mean
CS-2	1187.42	997.03	1167.0	1388.0	1184.9
CS-4	-	970.24	1075.0	1467.0	1170.7
Co-1	1223.14	956.85	1021.0	1321.0	1130.5
MS-1	1160.22	952.38	863.0	1138.0	1028.4
P-2	1123.11	940.48	1008.0	1333.0	1101.23
P-3	1182.96	867.56	800.0	1250.0	1025.13

At Jobner 15 accessions were evaluated against a local check. Nine accessions recorded more yield than the block average of 640 kg/ha. The results were in agreement with the previous year's results that the characters showed significant differences except umbels/plant and umbellets/plant. UD-373 and UD-41 gave higher grain yield, 9.97 and 8.60 q/ha respectively as against 8.49 q/ha for the local check. Even though the performance of the local check is good and well adapted to the local conditions of Rajasthan, the quality of the local strain is poor compared

Table 25. Performance of the coriander accessions under comparative yield trial at different centres for the year 1981-82
(Yield kg/ha)

Accessions	Jobner	Coimbatore	Vijapur	Guntur	Additional accessions at Guntur	Yield
CS-2	504	150	674	1388	CS-553	1238
CS-4	438	98	516	1467	Cul-2	1271
CS-6	329	286	441	375	MS-1	1138
CS-7	523	136	503	1208	MS-2	1104
Culture-270	543	265	411	-	MS-3	1138
Co-1	721 (LDRS)	176	964	1321	RC-1	1238
PS-360	686	-	445	1167	P_1	1283
GAU-1	456	-	516	1321	P_2	1333
UD-1	593	76	425	1263	P_3	1250
UD-20	669	108	784	904	P_4	1113
UD-21	744	71	512	1175	P_5	1179
UD-41	560	-	278	908	MD-4	1208
UD-373	997	-	490	696	Sechal (36-3)	1196
UD-374	728	-	621	667		
UD-322	792	-	-	-		
Local check	849	-	681	1000		
CS-5	-	129	507	1125		
S-33		4	-	-		
1085		148	-	-		
Mean	640	137	554	Mean for Guntur 1149		
CD (P=0.05)	104					
C.V.(%)	11.83					

to UD-41. The performance of the promising selections under comparative yield trial for the last five years are given in Table 27.

Table 27. Performance of the promising selections under comparative yield trial at Jobner (yield q/ha)

Selection	1977-78	1978-79	1979-80	1980-81	1981-82	Mean
UD-41	10.68	13.87	10.80	2.67	8.60	9.32
UD-373	-	-	-	2.85	9.97	6.41
UD-21	7.23	11.32	6.38	2.38	7.44	6.95
UD-20	8.05	10.05	7.56	2.02	6.69	6.87
Local check	7.56	5.95	3.91	2.22	8.49	5.61

Among the eleven accessions evaluated at Coimbatore for six seasons, Culture-270, a reselection from P2 consistently proved its superiority over the rest for winter season. For monsoon seasons, Co-1 was found to be promising. In general, the performance of the selection under CYT was very poor at Coimbatore. The block average was only 137 kg/ha and four accessions recorded more than the block average.

At Jagudan, significant differences in yield were observed among the 16 accessions tried under comparative yield trial. The accession Co-1 recorded the maximum yield of 964 kg/ha. Eight accessions recorded more than the block average of 554 kg/ha.

Crop Management

Experiment 52. Response of coriander to fertilizers (Jobner, Jagudan (Vijapur) and Guntur)

Fertilizer trials laid out at the above centres

during 1981-82 showed significant difference in yield between treatments. The fertilizer trial in coriander at Jobner showed significant increase in yield due to the application of N. Even though N2 (60 kg N/ha) and N3 levels (90 kg N/ha) showed no significant differences from N_0 there was no significant difference between N_1, N_2 and N_3. Among the three spacings tried 30 cm and 40 cm row spacing gave significantly higher yield than 20 cm. The results of fertilizer cum-spacing trials are given in Table 28.

Table 28. Fertilizer-cum-spacing trial in coriander at Jobner

Nitrogen (kg/ha)	Spacing (cm) S1 (20)	S2 (30)	S3 (40)	Mean
N_0	5.88	6.88	7.11	6.62
N_1(30)	6.30	7.90	7.96	7.39
N_2(60)	6.55	8.29	8.59	7.81
N_3(90)	6.91	8.12	8.32	7.78
Mean	6.41	7.79	7.79	
S.E.	0.49			
C.D. (5%)	1.42			
C.D. (1%)	1.90			
C.D. for N (5%)	0.82			
C.D. for spacing (5%)	0.71			

Among the different combinations, N_2 (60 kg N/ha), S_3 (40 cm) gave the highest yield whereas N_0 (no N) S_1 (20 cm) gave the lowest.

At Gunur, no significant difference in yield was observed due to increase in N level or application of FYM. But the interaction of these main factors influenced the yield significantly. The maximum yield was recorded in N_2 level of nitrogen (30 kg/ha) with FYM (10 tonnes/ha).

At Jagudan centre, the yield difference due to various treatment combinations were found to be highly significant. Application of nitrogen @ 60 kg/ha with a spacing of 40 x 15 cm gave the highest yield of 667 kg/ha which was 11.53% higher than the control.

CUMIN

Crop Improvement

Experiment 47. Germplasm collection, maintenance and selection

(Jobner and Jagudan (Vijapur)

The cumin germplasm comprised 53 entries at Jobner and 53 at Jagudan.

At Jobner the best yielding entries with lower disease incidences were UC-124 (486.7 kg/ha), UC-13 (440.96 kg/ha) and UC-93 (440.96 kg/ha). The different entries showed significant differences only for plant height and grades of blight and powdery mildew infection.

A comparative yield trial with eight entries were laid out at Jobner and Jagudan. In both the places the accessions showed significant differences for yield. Table 29 shows the performance of cumin under comparative yield at Jobner and Jagudan for the past two years. At Jagudan, Vijapur-5 recorded the maximum yield for both the years (581 and 357 kg/ha respectively). Compared to 1981 (block average: 434 kg/ha), the performance of the crop was poor in the 1982 season (block average: 301 kg/ha). At Jobner, during the year 1981, the crop failed due to wilt. During 1982, UC-198 recorded the maximum yield of 158 kg/ha followed by 142 kg in UC-192 and 128 kg in UC-194. The yield data for all other accessions were very poor.

Table 29. Performance of cumin under comparative yield trial at Jobner and Jagudan for the past two years.

Accessions	Jagudan (yield kg/ha)			Jobner (yield kg/ha)
	1981	1982	Mean	1982
MC-43	451	306	378	13
Vijapur-5	581	357	469	76
UC-19	410	300	355	93
UC-192	470	329	399	142
UC-194	460	349	404	128
UC-196	347	264	305	66
UC-198	-	-	-	158
RS-1	515	292	403	99
Control	238	214	226	13
Mean	434	301		88
CD (5%)	74.41	81.70	-	70.85
CV (%)	28.85	18.72	-	55.29

In the state level varietal trial, three varieties RS-1, MC-43 and UC-19 were tested against a local check at five locations, Jobner, Mandore, Sumerpur, Durgapura and Tabije. Very severe attack of wilt, powdery mildew as well as blight was recorded in all the centres, MC-43 being the most severely affected. Except at Tabiji, the varieties UC-19 and RS-1 performed better than the local check at all the centres.

FENUGREEK

Crop Improvement

Experiment 46. Germplasm collection, maintenance and selection in fenugreek
(Guntur, Coimbatore, Jobner and Jagudan)

Under the germplasm collections and evaluation of fenugreek, 36 entries were evaluated at Jobner, 40 at Guntur, 26 at Coimbatore and 69 at Jagudan (Vijapur).

Among the 36 entries evaluated at Jobner, wide range of variability was noticed for yield (6.49 q/ha in UM-109 to 18.26 q/ha in UM-50) and associated characters. The biometrical variations for different characters are given in Table 30. Nine accessions gave more than 15 q/ha. The released variety NLM (Prabha) yielded 15.76 q/ha.

Table 30. Biometrical variation in fenugreek types evaluated under germplasm at Jobner

Character	Range	G.Mean	S.E.	(C.V.%)
Days to flowering	65-83	71.4	2.5	6.05
Plant height (cm)	48-66	57.5	3.04	9.24
Primary branches/ Plant	5-6	5.8	0.52	15.76
Secondary branches/ Plant	1-4	3.0	0.84	48.34
Pods/plant	28-60	40.7	6.26	27.16
Pod length (cm)	9-11	10.7	0.59	9.77
1000 grain weight(g)	8-15	12.9	0.73	10.39
Yield/ha (q)	6-18	13.6	1.49	19.40

At Guntur, data could not be recorded for the 40 accessions under germplasm due to the very poor performance of collection. Heavy rains in the early stages and prolonged drought at later stages adversely affected the crop growth and yield.

Among the twentysix entries evaluated at Coimbatore, AC.No.390 recorded the highest grain yield of 445 g/plot of 14 sq.m. Other promising accessions were Ac.No.913, 947 and 980 with yields ranging from 430 to 435 g/plot.

Experiment 51. Comparative yield trial in fenugreek (Guntur, Coimbatore and Jobner)

A comparative yield trial with six selections from Jobner (UM-5, 17, 32, 34, 35 and NLM), one from Coimbatore (T.G.2336), one from Jagudan (I.C.9955) and one from Guntur (Lam Sel.I) were laid out at three locations, Guntur, Coimbatore, Jagudan and Jobner. At Jobner and Jagudan, the yield was very good where as Coimbatore and Guntur it was very poor.(Table 31).

Table 31. Performance of cumin accessions under comparative yield trial at different centres (yield kg/ha 1981-82.)

Accessions	Jobner	Jagudan		Guntur	Coimbatore
UM-5	1688	1636		313	115
UM-17	1695	1487		333	101
UM-32	1513	1642		354	24
Um-34	1838	1456		292	116
UM-35	1150	1618		271	144
Lam.Sel.I	1675	1422		417	126
UM-112	1990	..	Pusa Early tranching	333	..
Co.2336	1470	969		333	389
NLM	1715	1650		292	87
IC-9955	1668	1389		333	132
TC-1084	..	1026	CS 381 CS 383 CS 960	333 354 375	216
Local	1465	1476		354	
Mean	1634	1434			145
CD (5%)	22.0	160.41		335	

Table 32. Performance of the fenugreek accessions under comparative yield trial at Jobner

Entry	Days to flowering	Plant Height/ (cm)	Pod length (cm)	Grains/ pod	1000 grain wt.(gms)	Yield/ plant (gms)	Yield (q/ha)	Protein cont.(%)
1	2	3	4	5	6	7	8	9
UM-5	61.0	69.3	10.31	13.70	10.10	4.06	16.00	26.56
"-17	60.7	72.9	10.90	12.70	12.07	5.06	16.95	21.07
"-32	89.7	68.6	10.11	14.10	9.00	5.59	15.13	26.56
"-34	61.7	74.0	10.45	10.47	11.87	5.34	18.30	29.60
"-35	89.0	70.0	11.10	11.37	9.06	4.57	11.50	21.07
NLM	62.3	64.0	9.25	14.97	13.98	5.82	17.15	35.93
LAM Sel.I	61.0	67.3	10.74	13.05	12.40	5.18	16.75	25.00
G.F.(1)	59.0	64.7	11.13	10.30	14.01	6.43	16.60	-
T.G.1084	60.5	60.9	10.15	10.52	12.37	4.44	15.40	-
T.G.2336	61.9	65.7	9.31	10.72	12.33	4.49	14.70	26.56
Local Bobas	60.0	65.2	10.33	11.52	12.55	5.82	14.65	25.00
UM-112	60.0	78.2	10.86	13.17	11.42	5.76	19.90	-
SEm ±	0.91	2.96	0.44	0.14	0.35	0.232	0.080	-
CD at 5%	2.60	0.49	1.277	0.30	0.99	0.665	0.220	-
CD at 1%	3.50	11.40	1.717	0.51	1.34	0.894	0.300	-
C V	2.77	0.52	8.55	2.53	5.06	8.91	9.895	

At Guntur, apart from the above 9, five more including a local check were compared. Yield was maximum in Lam Sel.I (417 kg/ha) which was significantly higher when compared to other cultivars. The yield was very poor for all the cultivars due to adverse climatic factors. The block average was only 335 kg/ha and only 5 varieties yielded more than the block average.

At Jobner 12 varieties were compared (seven from Jobner, 2 from Coimbatore and one each from Guntur and Jagudan + the local check). The accessions showed significant differences for characters like days to flowering, plant height, pod length, grains/pod, 1000 grain weight, yield/plant as well as yield/ha. The accession UM-112 recorded the highest yield of 19.90 q/ha followed by UM-34 (18.38 q/ha) and NLM (17.15 q/ha). The performance of the varieties under comparative yield trial are given in Table 32. The crude protein content in these selections varied from 21.87% to 35.93%.

The yield data for the past four years showed that the performance of NLM and UM-34 was equally good. The data are given in Table 33.

Table 33. Yield data for the fenugreek varieties under comparative yield trial at Jobner (yield q/ha)

Varieties	1978-79	1979-80	1980-81	1981-82	Mean
UM-5	15.37	16.42	12.67	16.88	15.34
UM-17	15.71	17.20	11.62	16.95	15.37
UM-32	16.22	14.35	13.60	15.13	14.82
UM-34	17.57	19.87	13.95	18.38	17.44
UM-35	16.63	14.81	14.52	11.50	14.36
Lam Sel.I	15.18	11.90	12.17	16.75	14.00
UM-112	14.10	12.76	11.70	19.90	14.67
Co.2336	12.85	11.22	13.40	14.70	13.04
IC-9955 (G.F.I)	15.14	11.27	10.37	16.68	13.36
NLM	19.67	17.67	14.17	17.15	17.17
Local (Bobas)	12.62	16.95	10.88	14.65	13.28
CD (5%)	3.88	2.20	2.20	0.30	

In another trial six varieties were compared at three different locations, Banswara, Durgapura and Jobner. At Durgapura, the crop showed very good performance. The yield varied from 30-37.55 q/ha, the maximum being in NLM (Prabha). At Jobner UM-34 (18.38 q/ha) and NLM (17.15 q/ha) gave the maximum yield, whereas at Banswara, the local check recorded the maximum yield of 10.36 q/ha. When compared to the overall mean, it was observed that NLM (Prabha) recorded the highest yield (21.87 q/ha) as against 20.49 q/ha for the local checks. The yield data are given in Table 34.

Table 34. Yield data for the fenugreek varieties under comparative yield trial at different locations (Yield q/ha) (1981-82)

Varieties/ Location	Banswara	Durgapura	Jobner	Mean (1981-1982)	Mean yield(q/ha) (1978-82)
UM-5	9.50	30.05	16.88	18.21	12.68
UM-17	8.33	35.40	16.95	20.26	12.83
UM-32	8.33	30.15	15.13	17.87	11.15
UM-34	8.58	31.08	18.38	19.35	12.97
UM-35	9.00	32.95	11.50	17.86	12.32
NLM	8.50	37.55	17.15	21.07	14.79
Local check	10.36	36.45	14.65	20.49	12.50
CD (5%)	1.27	0.47	0.30		

The average yield for the past four years (1978-79 to 1981-82) also showed superiority of NLM (14.79 q/ha) as against 12.50 in the check.

Among the 6 varieties compared at Coimbatore for four seasons, the accession, TG-2336 was found to be the most promising one (yield 565 g/14.5 sq.m. plot). This accession recorded maximum yield in 1980-81 also.

Crop Management

Experiment 53. Response of fenugreek to fertilisers (Jobner and Jagudan (Vijapur)

During the period under report an experiment consisted of combinations of three dates of sowing viz., 7th November, 17th November and 27th November, and three row spacings, viz., 20 cm, 30 cm and 40 cm. were tried at Jobner. Data showed that early sowing gave more yield than late sowings and closer spacings (20 cm and 30 cm) gave significantly higher yield than 40 cm. (Table 35).

Table 35. Effect of sowing date and row spacings on the yield of fenugreek at Jobner. (Yield q/ha.)

Date of sowing/ Spacing	S1 (20cm)	S2 (30cm)	S3 (40cm)	Mean
D1 (7th Nov.)	18.31	17.77	15.34	17.14
D2 (17th Nov.)	14.81	17.58	14.92	15.77
D3 (27th Nov.)	14.28	11.82	11.77	12.63
Mean	15.80	15.73	14.01	
CD (5%) for sowing	0.45			
CD (5%) for spacing	0.52			

FENNEL

Crop Improvement

Experiment 49. Germplasm collection, maintenance and selection in fennel.
(Guntur, Jagudan and Jobner)

Fourteen accessions were evaluated at Guntur, of which U.F.31 has recorded the highest yield (1312 kg/ha). This accessions recorded maximum yield in 1980-81 season also. However, the quality of this accession is poor and the colour also is not attractive.

One hundred entries along with six checks were evaluated at Jobner. Thirteen entries recorded more yield than the checks. UF-32 recorded the maximum yield of 8.14 q/ha followed by 6.9 q/ha in UF-95. All the accessions were susceptible to blight.

The fennel germplasm comprises 179 collections at Jagudan.

Like the previous year, the seven entries under comparative yield trial did not show any significant difference as far as yield is concerned. Lam Selection II and UF-32 were the high yielders with an yield of 9.83 and 9.68 q/ha respectively. The protein content varied from 10.93% in UF-32 to 18.75% in PF-35.

In another trial five selections, UF-31, UF-32, Mass selectionII, PF-35 and S-7-9 were compared along with checks at two locations at Sumerpur and Jobner. At Sumerpur, all the varieties showed good performance. The maximum yield of 13.05 q/ha was recorded in UF-31. At Jobner, there was no significant differences between different varieties. The data are presented in Table 36.

Table 36. Performance of fennel varieties under comparative yield trial at Jobner & Sumerpur

Varieties	Locations	Days to flowering	Yield/plant (gm)	Yield q/ha
UF-31	Sumerpur	-	-	13.05
	Jobner	107.00	21.12	8.30
UF-32	Sumerpur	-	-	11.37
	Jobner	106.00	20.62	9.68
Mass Sel.	Sumerpur	-	-	12.13
	Jobner	109.75	22.88	9.18
PF-35	Sumerpur	-	-	10.83
	Jobner	105.75	16.00	8.20
S-7-9	Sumerpur	-	-	10.60
	Jobner	104.00	22.50	9.48
Local check	Sumerpur	-	-	9.40
	Jobner	112.50	21.13	9.30
SEm ±	Sumerpur	-	-	0.05
	Jobner	2.10	0.30	0.87
CD at 5%	Sumerpur	-	-	0.15
	Jobner	N.S.	N.S.	N.S.
CV %	Sumerpur	-	-	27.28
	Jobner	4.07	2.54	19.34

Table 37. Yield data on NPK fertilizer trial on [illegible] at Jagudan during 1979-82

Treatment	Yield (kg/ha)			Total	Average	Percentage increase over control
	79-80	80-81	81-82			
N_0P_0	859	287	735	1881	627	9.94
N_0P_{15}	868	304	896	2068	689	9.94
N_0P_{30}	862	311	927	2100	700	11.64
$N_{15}P_0$	939	446	1029	2414	805	28.34
$N_{15}P_{15}$	1046	383	1077	2506	835	33.22
$N_{15}P_{30}$	1063	338	1080	2480	827	31.85
$N_{30}P_0$	857	421	715	1993	664	5.95
$N_{30}P_{15}$	1081	387	1079	2547	849	35.41
$N_{30}P_{30}$	1003	491	1126	2623	874	39.45
$N_{45}P_0$	1075	382	874	2331	777	23.02
$N_{45}P_{15}$	1219	459	1022	2700	900	43.54
$N_{45}P_{30}$	1192	413	941	2546	849	35.25
N_0P_0 + W.spray	692	261	773	1726	575	-
N_0P_0 + Zn	787	321	890	1998	666	6.22
N_0P_0 + B	869	320	638	1827	609	-
N_0P_0 + Zn + B	970	344	1015	2329	776	23.81
$N_{15}P_{15}$+Zn + B	1094	378	1231	2703	901	43.70
$N_{45}P_{30}$ + Zn + B	1288	472	1360	3120	1040	65.87
$N_{90}P_{60}$	1186	521	1396	3103	1034	64.97
$N_{90}P_{60}$ + Zn +B	1124	544	1290	2958	986	57.26
S.E. + Kg/ha	137.00	33.89	118.00		62.80	
C.D. (5%)	304.25	97.09	339.10		175.81	
C.V. (%)	23.87	14.98	20.46		24.66	

The accessions (UF-31, UF-35 and S-7-9, Lam Selecti n I, Lam Selection II, Mass selection, PF-35 and S-7-9 and control) tested under comparative yield trial at Jagudan showed significant differences for yield. Analysis of the pooled data for the past three years showed that the accessions PF-35 recorded the maximum yield for all the three years (Av. 1095 kg/ha).

Crop Management

Experiment 50. Response of fennel to fertilizers (Jagudan)

This is the third year of the trial at Jagudan. The treatment consists of four levels of N2 (0, 15, 30 and 45 kg/ha) and three levels of P_2O_5 (0,15 and 30 kg/ha), along with eight more treatments, viz., N_0P_0 + Water spray, N_0P_0 + Zn, N_0P_0 + B, N_0P_0 + Zn + B and $N_{15}P_{15}$ + Zn+B, $N_{45}P_{30}$+Zn+B, $N_{90}P_{60}$+Zn+B and $N_{90}P_{60}$. Analysis of the pooled data for the last three years showed that the treatment combinations $N_{45}P_{30}$+Zn+B could be more beneficial to get maximum yield (1040 kg/ha) (Table 37).

During the year 1982, the combination $N_{90}P_{60}$ has given the highest yield of 1396 kg/ha. However, no significant difference could be obtained for the main effect of N or P or their interaction. Only Zn alone in combination with $N_{45}P_{30}$ showed significant increase in yield. Hence the combination $N_{45}P_{30}$Zn+B would be beneficial to increase the yield in fennel.

CHAPTER II: ORGANISATION

FUNCTIONING OF CO-ORDINATED PROJECT

ORGANISATION

Functioning of Coordinated Project

The All India Coordinated Spices and Cashewnut Improvement Project envisages co-ordinated research on spices and cashewnut with the main objective of increasing the production and productivity of these crops.

The project started functioning in 1971 with the headquarters at CPCRI, Kasaragod and 10 coordinating centres located in different agro-ecological regions of the country to take up research on cashew and major spices like pepper, cardamom, ginger and turmeric. During the Vth Plan, six more centres were added, one for cashew at Bhubaneswar, one for ginger and turmeric at Pottangi and four for condiments at Guntur, Jobner, Vijapur (Jagudan) and Coimbatore. In the VI Plan, two centres for cashew (Karnataka and West Bengal), two for pepper in the non-conventional areas (Andhra Pradesh and Karnataka), one for cardamom in Tamilnadu and one for ginger in Kerala have been added.

The first workshop of AICSCIP was held at Kasaragod in December 1971, to review the research work done on the improvement of these crops, to identify the problems, and to draw up the technical programmes. Detailed technical programmes were drawn up for each of the centres, taking into consideration the priority of the problems and facilities available under the project. Group meetings were held to identify specific problems of each of the crops covered under the project. The progress of work was reviewed and detailed technical programmes, with necessary modifications were drawn up at the Workshops held in 1972, 1975, 1978 and 1981.

Most of the crops covered under the project are of perennial nature and conceivably the programmes take longer period to give results. Thus, though the project started functioning in 1971 (during IVth plan period) the first variety of cashew could be released only during the Sixth Plan period. Eleven improved varieties of cashew (4 hybrids and 7 selections have been released for cultivation by the State Varietal Release Committees on the recommendation of the Workshop. In coriander, two varieties have been released.

Azhukal disease is a serious problem in cardamom in the High Ranges of Kerala and chemical control for the disease has been worked out and recommended to the cultivators. Tea mosquito is a serious problem in the cashew plantations. Chemical control against the pest has been worked out and recommended to the cultivators.

The Centre-wise staff position including the Co-ordinating unit is given in appendix I.

Two new centres, one for cashew research at Chinthamani and the other for Pepper research under malnad conditions of Karnataka at Sirsi were sanctioned under UAS, Bangalore during the Sixth Plan. The project has not started functioning at Sirsi. At Cashew Research Centre, Chinthamani, the farm superintendent was put in charge. For Sirsi centre, technical programmes were not drawn up during the Vth workshop, as there was no staff at this centre.

Chinthapalli is another new centres under Andhra Pradesh Agricultural University for research on pepper in non-conventional area. This centre also has not started functioning yet.

Among the centres started during the IVth Plan period, Cardamom Research Station, Mudigere and Pampadumpara have maximum number of vacancies. At Mudigere out of four scientist provided in the project only an Agronomist is in position. At Pampadumpara also only one out of the four scientists provided was in position till March 1982, and two more scientists joined between March and June 1982.

The position at Solan, a centre under Himachal Pradesh Agricultural University for research on ginger and turmeric also is equally unsatisfactory.

Director of research, Deans and Registrars of the concerned universities have been contacted personally and through letters and impressed upon them the need to appoint the staff and implement the programme as per schedule. The staff position in other centres is satisfactory.

The Project Coordinator has been visiting the centres periodically. However, because of the lack of technical and administrative support in the Coordinator's cell, it has not been possible for him to visit the centres more frequently.

A group meeting of the scientists working on annual spices (ginger, turmeric, coriander, cumin, fennel and fenugreek) was organised at Jobner (Rajasthan) during November 1982.

Inadequacy of finance is an important constraint in the development of facilities and infrastructure for the research centres under the project. Being a perennial crop, the area required for each experiment is quite large and consequently the contingent expenditure required for laying out and maintenance of each experiment is quite large and consequently the contingent expenditure required for laying out and maintenance of each experiment is quite large and therefore the privision @ Rs.8000/- per scientist is quite inadequate to meet the contingent expenditure

at the centres. Land and physical facilities required for the centres also are quite large and this require additional support.

The coordinating Unit consists of only a Project Coordinator, a Stenographer and a Junior Statistician. The Project has 20 centres covering nine crops. In addition, the Project Co-ordinator has been put in additional charge of the Multi-State Cashew Project as well, without any additional support. In the absence of adequate administrative and technical support, it has been found impossible to discharge the duties of the Project Coordinator effectively.

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AICSCIP STAFF STRENGTH AND PERSONNEL

Sanctioned Staff	Personnel
CO-ORDINATING UNIT	
Project Co-ordinator	Dr. M.C. Nambiar
Jr. Statistician	K Vijaya Kumar
Stenographer	T.K. Narayanan Nambiar
CASHEW RESEARCH STATION, MADAKKATHARA	
Agronomist (Hort.)	PG Veeraraghavan
Jr.Entomologist	D Sitarama Rao
Sr.Research Asst.	TE George
CASHEW RESEARCH STATION, BAPATLA	
Horticulturist (Breeder)	N Subba Rao Asst.Breeder
Jr.Entomologist	M Ramadevi
Jr.Agronomist	Vacant
Sr.Research Asst.	P Radhakrishna Murthy
CASHEW RESEARCH STATION, VRIDHACHALAM	
Horticulturist	R Arumughan KP Palaniswami
Jr.Horticulturist (Agr.)	D Veeraraghavathatham
Jr.Entomologist	M Ganesh Kumar
Sr.Research Asst.	P Rajendran
CASHEW RESEARCH STATION, VENGURLA	
Horticulturist	DP Sawke
Jr.Breeder	Vacant
Jr.Entomologist	SK Godase
CASHEW RESEARCH STATION, BHUBANESWAR	
Agronomist	JM Panda
Jr.Entomologist	BC Jena
CPCRI REGIONAL STATION, VITTAL	
Breeder	KN Murthy
Biochemist	Vacant
Scientist S1(Breeding)	Vacant (on study leave)
Scientist S1 (Breeding)	K.V.J. Mohan

CARDAMOM RESEARCH STATION, PAMPADUMPARA

Plant Pathologist	P Karunakaran
Breeder	K Vasantha Kumar
Agronomist	GK Balachandran Nair
Jr.Entomologist	Vacant

CARDAMOM RESEARCH STATION, MUDIGERE

Breeder	Vacant
Agronomist (Hort.)	GS Sulikere
Pathologist	Vacant
Jr.Entomologist	Vacant
Jr.Physiologist	Vacant

PEPPER RESEARCH STATION, PANNIYUR

Nematologist	S Sasikumaran
Jr.Breeder	C Chandy
Jr.Pathologist	PK Unnikrishnan Nair
Jr.Agronomist	V Sukumara Pillai (addl.charge)

HIMACHAL PRADESH UNIVERSITY, SOLAN

Breeder	U.K.Kohli (addl.charge)
Jr.Pathologist	Vacant
Jr.Biochemist	Vacant

HIGH ALTITUDE RESEARCH STATION, POTTANGI

Breeder	DC Mohanty
Jr.Breeder	Vacant
Sr.Research Asst.	YN Sharma

SKN COLLEGE OF AGRICULTURE, JOBNER

Sr.Breeder	Vacant
Breeder	RK Sharma
Jr.Pathologist	LG Bhatnagar
Jr.Biochemist	RC Sharma
Jr.Agronomist	DS Bhati
Sr.Research Asst.	JP Loyal

REGIONAL AGRICULTURAL RESEARCH STATION, GUNTUR

Horticulturist	Vacant
Jr.Breeder (Hort.)	T Srirama Rao
Jr.Pathologist	Vacant

AGRICULTURAL SPICES RESEARCH STATION, JAGUDAN

Pathologist	Vacant
Jr.Breeder (Hort.)	BT Kachhodia

TAMIL NADU AGRICULTURAL UNIVERSITY, COIMBATORE

Breeder	Seemanthini Ramadas
Jr.Pathologist	Vacant

CASHEW RESEARCH STATION, WEST BENGAL

Jr.Horticulturist	Vacant
Jr.Entomologist	Vacant
Sr.Research Asst.	Vacant

CASHEW RESEARCH STATION, CHINTAMANI

Horticulturist (Agr.)	Vacant
Jr.Horticulturist(Breeder)	Vacant
Jr.Entomologist	Vacant
Sr.Technical Asst.	Vacant

CARDAMOM RESEARCH STATION, YERCAUD

Agronomist (Hort.)	K Nanjan
Jr.Breeder	Vacant
Jr.Pathologist	Vacant
Jr.Entomologist	Vacant

PEPPER RESEARCH STATION, CHINTAPALLI

Horticulturist (Agr.)	Vacant
Jr.Pathologist	Vacant
Sr.Technical Asst.	Vacant

COLLEGE OF HORTICULTURE, TRICHUR

Agronomist (Hort.)	EV Nybe
Jr.Pathologist	TN Vilasini
Jr.Entomologist.	Vacant

PEPPER RESEARCH STATION, SIRSI

Jr.Horticulturist	Vacant
Sr.Pathologist	Vacant
Sr.Technical Asst.	Vacant

AICSCIP BUDGET

Centre	Sixth Plan Provision						Expenditure	
	1980-81	1981-82	1982-83	1983-84	1984-85	Total	1980-81	1981-82
Madakkathara	79,000	1,16,000	1,18,000	1,24,000	1,09,000	5,48,000	75,902	1,13,204
Bapatla	1,11,000	1,42,000	1,51,000	1,68,000	1,56,000	7,28,000	91,850	1,53,928
Vridhachalam	90,000	1,36,000	1,54,000	1,48,000	1,32,000	6,60,000	71,441	1,17,021
Vengurla	75,000	1,03,000	1,23,000	1,32,000	1,14,000	5,49,000	83,809	77,937
Bhubaneswar	64,000	81,000	1,25,000	1,03,000	82,000	4,55,000	51,913	52,448
Pampadumpara	1,14,000	1,97,000	1,78,000	1,82,000	1,56,000	8,27,000	72,980	1,35,148
Mudigere	1,17,000	1,59,000	1,91,000	1,96,000	1,72,000	8,35,000	79,572	83,976
Panniyur	1,12,000	1,49,000	1,56,000	1,40,000	1,44,000	7,01,000	1,01,563	1,40,448
Solan	74,000	1,17,000	98,000	1,02,000	1,06,000	4,97,000	52,818	1,07,885
Pottangi	1,26,000	1,01,000	1,00,000	94,000	1,00,000	5,21,000	57,320	63,665
Jobner	1,11,000	1,54,000	1,78,000	1,64,000	1,59,000	7,66,000	56,084	1,51,866
Guntur	58,000	1,02,000	1,09,000	93,000	1,03,000	4,70,000	62,920	76,120
Jagudan	56,000	1,00,000	72,000	74,000	76,000	3,78,000	62,184	65,995
Coimbatore	57,000	77,000	90,000	73,000	77,000	3,74,000	67,104	68,124
West Bengal	8,200	54,000	1,09,000	72,000	75,000	3,18,200	-	29,632
Chintamani	-	38,000	1,43,000	1,28,000	1,22,000	4,31,000	-	19,859
Yercaud	18,000	1,43,000	1,18,000	1,07,000	1,12,000	4,98,000	-	19,371
Chintapalli	-	19,000	97,000	95,000	87,000	2,98,000	-	4,979
Trichur	14,000	51,000	1,03,000	1,02,000	90,000	3,60,000	-	39,822
Sirsi	-	23,000	88,000	87,000	80,000	2,78,000	-	-
Total(Rs.in lakhs)	12.84	20.62	25.01	23.91	22.54	104.92	9.88	15.21
ICAR Share(75%)	9.63	15.46	18.76	17.94	16.90	78.69	7.41	11.41
Univ.Share(25%)	3.21	5.16	6.25	5.97	5.64	26.23	2.47	3.80