

1. SUMMARY

The sub-project for research and training under the Kerala Agricultural Development Project was started on 18-4-77 with the appointment of a Special Officer for the purpose. The project envisages the conduct of intensive research on coconut, cashew, pepper and cocoa. Imparting training to the technical staff in the development project is also a major programme to be undertaken by the Kerala Agricultural University under this sub-project.

The project work started with full intensity by June 1978 when most of the scientific staff were in position. Altogether 47 projects have been initiated in the four crops namely coconut(14), Cashew(9), Cocoa(10) and Pepper(14), of which a few have been concluded.

The salient findings from these experiments are as follows:

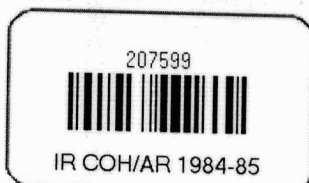
Initial take in epicotyl grafting in cashew is very high. However, the percentage success declined later and finally after two months of grafting the success in this method was only 5-16%.

Uptake of Zn, Mn and K by black pepper was affected adversely following soil inoculation with the gall-forming nematode, Meloidogyne incognita.

Quickwilt control measures as per package of practices continued to give effective control of anthracnose infection in black pepper.

During the year under report no training was conducted.

The budget allotment for the year 1984-85 was Rs.26,01,000/-. However, an amount of Rs.9,12,667.54 has been spent during the year.



2. INTRODUCTION

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The Kerala Agricultural University and the Central Plantation Crops Research Institute have been conducting research on the production problems of the important commercial crops of Kerala like Coconut, Pepper, Cashew and Cocoa. But the research input, on these crops, has to be intensified so as to provide the necessary support for the successful implementation of the massive programmes already underway. The work in progress under the Kerala Agricultural Development Project at the Kerala Agricultural University are of fundamental, applied and adaptive nature with particular reference to the different agro-climatic zones of Kerala. Training of the extension personnel employed under the SADU is also included in the programme. Apart from experiments in various research stations, adaptive trials on all these crops are being conducted in cultivators' gardens. The programmes by the Kerala Agricultural University and the Central Plantation Crops Research Institute are complementary and are being implemented with close co-operation and co-ordination.

3. ORGANISATION AND MANAGEMENT

The position of staff in the KADP is as follows:

3-1. Professors(5)

Professor of Horticulture(Coconut):

Dr.K.Kumaran

9-3-82 to 31-3-85

Professor of Horticulture(Cocoa) :

Dr.R.Vikraman Nair

- 20-10-81 to 31-3-85

Professor of Horticulture(Cashew) :

Prof.K.K.Vidyadharan

- 1-4-81 to 31-3-85

Professor of Horticulture(Pepper) :

Dr.Abi Cheeran

- 1-4-81 to 31-3-85

Professor(Radiotracer) :

Dr.P.A.Wahid

- 16-3-82 to 31-3-85

3-2. Associate Professors(2)

Associate Professor(Instrumentation):

K.Madhavan Nair

- 1-4-81 to 31-3-85

Associate Professor(Safety Officer):

N.V.Kamalam

- 1-4-81 to 31-3-85

3-3- Assistant Professors(4)

Assistant Professor(Soil Science) :

P.C.Antony

- 5-1-83 to 31-3-85

Assistant Professor(Horticulture) :

N.K.Parameswaran

- 3-4-84 to 13-6-84 AN.

M.Abdul Wahab

Vacant from 14-6-84 to 8.7.84.

Assistant Professor(Nematology) :

Arthur Jacob

- 9-7-84 to 31-3-85

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Vacant from

Assistant Professor(Biochemistry) :

Augustin,A.

- 1-4-81 to 31-3-85

3-4. Junior Assistant Professors(2):

Jr.Asst.Professor(Virology) :

Vilasini,T.N.

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- 25-11-83 to 31-3-85

4. PROJECT IMPLEMENTATION

4-1. Training

During the year under report no training courses were conducted.

4.2. Research

4.2.1. RESEARCH PROJECTS ON COCOA

1. KADP Ag.8(c) 19.1 Propagational studies on cocoa
2. KADP Ag.8(c) 19.2 Trials on training and pruning of cocoa.
3. KADP Ag.8(c) 19.3 Nutritional studies on cocoa.
4. KADP Ag.8(c) 19.4 Studies to determine the optimum shade requirement for cocoa.
5. KADP Ag.8(c) 19.5 Control of insect pests of cocoa.
6. KADP Ag.8(c) 19.6 Studies on the management of squirrels infesting cocoa pods.
7. KADP Ag.8(c) 19.7 Investigation on the etiology of fruit drop disease and their control.
8. KADP Ag.8(c) 19.8 Control measures for pink disease (Corticium salmonicolor)
9. KADP Ag.8(c) 19.9 Studies on the die-back disease of cocoa- causes and control.
10. KADP Ag.8(c) 19.10 Post harvest microbial deterioration of cocoa.

1. KADP Ag.8(c)19.1 Propagational studies on cocoa.

(1) Germplasm collection in cocoa

The six groups of germplasm collections field planted at Vellanikkara were maintained. In the budded type, the maximum number of budded plants of each type was kept as five. The present position of germplasm collection of cocoa is given in Table 1.

Table 1. Germplasm collection of Cocoa at Vellanikkara.

Germplasm No.	Number of types	Number of plants	Year of field planting.	Nature of material
G-i	15	173	1979	Seedlings from 15 pods received from the Cocoa Research Institute, Ghana.
G-ii	--	135	1980	Seedlings from pods of promising plants.
G-iii	--	99	1980	"
G-iv	--	230	1980	"
G-v	52	72	1981	Budded plants of 52 types from promising plants.
G-vi	126	240	1983	Budded plants from 126 types, mainly exotic - 59 from CPCRI, Regional Station, Vittal. 14 from Cadbury Farm, Thamarassery; 6 from CPCRI Sub-Station, Kannara and 47 from RARS, Pilicode.

(2) Hybridisation work in cocoa.

Based on the yield data of about 680 plants available at the Agricultural Research Station, Mannuthy during 1982, 20 high yielding trees were selected. A selection index was worked out based on the pod yield and wet bean weight per pod of the 13 high yielding trees and in general, it was found that plants showing higher pod yield gave higher selection index values. Seven of the 20 high yielding trees whose bean characters were not studied and which gave generally low pod yield values were discarded.

The pod yield, wet bean weight per pod, selection index and self-compatibility status of the 13 high yielding trees in the decreasing order of selection index is given in table 2.

Table 2. The pod yield, wet-bean weight per pod, selection index and self-compatibility status of the 13 high-yielding trees in the decreasing order of selection index.

Sl.No.	Tree No.	Selection index	Self compatibility
1	12.21	5234.56	SIC
2	19.7	4776.00	NA
3	16.9	4706.75	SIC
4	9.16	4380.00	SIC
5	16.16	4125.00	SC
6	18.7	3982.43	SIC
7	17.12	3630.15	NA
8	13.12	3116.00	SIC
9	2.16	2730.00	SIC
10	13.5	2400.00	NA
11	4.18	2240.00	SIC
12	21.19	2132.00	SC
13	5.18	1930.50	SIC

NA - Self-compatibility not studied

SIC - Self-incompatible

SC - Self-compatible.

The plants 19.7, 17.12 and 13.5 had dried up in the drought of 1982-83. Discarding the self-compatible and dried up plants, the best self-incompatible mother plants are 12.21, 16.9, 9.16, 18.7 and 13.12. These were designated as Trichur locals.

Male plants were selected from the Ghanian collections and exotic budded types. The Ghanian types are V15.5, V10.3, V5.9, V9.6 and V4.8. The exotic budded types are IMC67, Na31, MOQ413, SIAL93, IMC10, EET272, Na33, C6, C3 and P7C.

Cross pollination studies were conducted between the selected female and male plants. A total of 952 hand pollinations were done as follows. Between five Trichur locals and five Ghanian types 279 hand pollinations were done. Out of these 38 pods are developing. Taking the five Ghanian types as female parents, 586 hand pollinations were done with the ten exotic budded types. Of these 164 pods are developing. Again crosses were made with the five Kerala locals (tree nos.7.4, 11.4, 12.3, 19.5 and 20.4 from the Germplasm II Populations at Vellanikkara) as female parents with the ten budded exotic types and 75 pods are developing.

(3) Effect of size of pods and position of seeds within the pods on germination, seedling vigour, growth and yield are proposed to be studied in this experiment. Mature Forestero pods were grouped into small, medium and big (n=100 pods) and 10 pods of each group were selected. The seeds from each group were extracted from one-third portions of distal and pedicel ends and also from the middle. The seeds from each group were pooled and sown in polybags during 1978-79. The seedlings from the above treatment combinations numbering 9 were field planted in 1979 to study the growth and yield. Data on girth, height and canopy spread and yield were recorded. The results showed that there was no difference between treatments on the growth characters and yield.

2. KADP Ag.8(c) 19.2 Trials on training and pruning of cocoa.

This field trial was started in 1981 at Vellanikkara to study the extent of pruning required for cocoa. The treatments consist of

1. Training to 1-1.5m height, developing a single tier and pruning the remaining.(T₁)
2. Training to 1.5-2m height, " " (T₂)
3. Training to 2-2.5m height, " " (T₃)
4. Training to 1-1.5m height and developing a second tier 1.5m above the first (T₄)
5. Same as in 2 and second tier 1-1.5m above first(T₅)
6. Same as in 3 and second tier 1-1.5m above first(T₆)
7. Control(without pruning)(T₇).

Training and pruning were done as per the treatments. Data on girth, height upto the jorquette and canopy spread were recorded. The results showed no significant difference among treatments with respect to the height of the plants whereas the girth and canopy spread varied significantly at 1% level. Data on mean girth and canopy spread are given in Table 3.

Table 3: Mean girth and canopy spread during January '84. of the training and pruning trial plants.

Treatments	Mean girth(cm)	Mean canopy spread(cm)
T1	7.30*	42.21
T2	6.62	30.72
T3	6.70	33.82
T4	6.28	32.13
T5	6.48	34.64
T6	6.96	35.97
T7	9.63	78.09
F-test	Significant at 1%level	Significant at 1%level
CD	1.44	12.33

* - Mean of four replications.

Maximum girth and canopy spread were higher in the control plants.

3. KADP Ag.8(c) 19.3 Nutritional studies on cocoa

There are three experiments under this project, requirement of N,P,K, Ca and Mg of cocoa, requirement of N,P and K of budded cocoa and effect of zinc on the growth and production of cocoa.

(1) Requirement of N,P,K, Ca and Mg of cocoa.

This experiment was laid out at four farmers' fields two in Trivandrum and two in Trichur districts. The experiments were laid out in 1979 in Trivandrum district at Elamba and Karakulam and that of Trichur at Kannara. To represent sandy soils, the experiment at Vadanappally was initiated in 1983 and the yeild data of the plants were collected for a year. After calibrating the plants based on pre-experimental yield, the fertilizer application as per treatments was commenced from May-June, 1983. The treatments of the experiment include five levels of fertilizer combinations of N,P,K,Ca and Mg with a control. The treatment details are given in table 4.

Table 4. Treatment details of N,P,K, Ca and Mg requirement of cocoa.

Treatments	gm/plant/year				
	N	P ₂ O ₅	K ₂ O	CaO	MgO
T ₁	50	20	70	15	15
T ₂	100	40	140	30	30
T ₃	150	60	210	45	45
T ₄	200	80	280	60	60
T ₅	250	100	350	75	75
T ₆	Compost or cattle manure @ 15 kg/plant				

The fertilizers were applied in two equal splits, once in May-June and again in Sept-Oct. Compost was applied once by May-June. Soil and leaf samples were collected after fertilizer application and analysed for nitrogen, available phosphorus and available potassium in the case of soil and nitrogen, phosphorus and potassium in the case of leaf samples. Soil and leaf sample analysis data at Elamba, Kannara and Vadanappally are given in Tables 5,6 and 7.

Table 5. Leaf sample analysis data at Elamba during Sept.'84.

Treatments	N(%)	P(%)	K(%)
T ₁	1.55	0.094	2.30
T ₂	1.53	0.103	2.20
T ₃	1.51	0.110	2.23
T ₄	1.59	0.106	2.24
T ₅	1.56	0.088	2.30
T ₆	1.24	0.065	1.56
F-test	Not significant	Not significant	Not significant
CD	-	-	-

(Soil sample not collected during Sept.'84)

Table 6. Soil and leaf sample analysis data at Kannara during Sept.'84.

Treatments.	Soil samples			Leaf samples		
	N%	Avai. P ₂ O ₅ Kg/ha.	Avai. K ₂ O Kg/ha.	N%	P(%)	K(%)
T ₁	0.108	269.00	522.50	1.823	0.097	1.513
T ₂	0.121	270.00	637.50	1.900	0.088	1.700
T ₃	0.131	302.50	520.00	1.878	0.085	1.690
T ₄	0.135	331.75	485.00	1.958	0.075	1.630
T ₅	0.137	312.00	440.00	1.828	0.075	1.640
T ₆	0.135	307.50	440.00	1.853	0.094	1.810
F-test	Significant at 1% level.	Not significant.	Not significant.	Not significant.	Not significant.	Not significant.
CD	0.04	-	-	-	-	-

Table 7. Soil and leaf sample analysis data at Vadanappally during Sept.'83(pre-experimental period) and Sept.'84(experimental period)

Treatments	Soil sample						Leaf sample					
	N(%)		Avai. P ₂ O ₅ Kg/ha.		Avai. K ₂ O kg/ha.		N(%)		P(%)		K(%)	
	PE*	E**	PE	E	PE	E	PE	E	PE	E	PE	E
T ₁	0.070	0.079	132.22	142.22	124.00	112.00	2.40	1.48	0.1875	0.10	1.73	1.88
T ₂	0.077	0.089	163.33	177.78	133.50	120.00	2.09	2.10	0.194	0.075	1.70	1.95
T ₃	0.080	0.102	153.34	311.12	120.00	150.00	1.59	1.76	0.175	0.175	1.82	2.13
T ₄	0.065	0.076	163.33	386.66	125.50	138.00	1.73	1.70	0.156	0.175	1.79	2.03
T ₅	0.072	0.088	257.77	755.56	109.50	168.00	1.42	1.76	0.128	0.138	1.80	2.15
T ₆	0.091	0.059	115.56	128.88	129.00	130.00	1.24	1.42	0.176	0.100	1.85	2.18

* - Pre-experimental period

** - Experimental period

foliage was started using existing cocoa plants of the Instructional Farm, Mannuthy. Application of $ZnSO_4$ was given by Sept.Oct. Data on yield of pods were recorded. The results showed that there is no significant difference between treatments in the yield of pods. The experiment is being continued.

(3) N,P and K fertilizer trial on budded plants:

This experiment was started during July 1983. The experiment is in confounded factorial design with three replications. The treatments consist of three levels each of N, P_2O_5 and K_2O as follows.

Levels of N(g/plant/year) - 0,100,200 (n_0, n_1, n_2)

Levels of P_2O_5 (g/plant/year)-0,40,80(p_0, p_1, p_2)

Levels of K_2O (g/plant/year)-0,140,280 (k_0, k_1, k_2)

Budded plants of plant no.20/20(from the populations at Mannuthy) constituted replication I and II and budded plants of plant No.5/18(from the populations at Mannuthy) constituted replication III. First dose of fertilizers was applied in August, 1983. One-third dose was given. Second 2/3 dose was applied in June, 1984. Data on height and canopy spread were recorded. The results showed that nitrogen had a significantly superior performance on the canopy spread of the plants. Responses to phosphorus and potassium were not significant. Within the three levels of nitrogen n_1 and n_2 were on par and significantly superior to n_0 . The mean canopy spread of the plants at three levels of nitrogen is given in Table 9.

Table 9. Mean canopy spread of the NPK fertilizer trial plants at three levels of nitrogen during Jan.'85.

Levels of nitrogen	Mean canopy spread(cm)*
n_0	129.41
n_1	164.22
n_2	158.50
F-test	Significant at 1% level
CD	19.72

* - Mean of three replications.

4. KADP Ag.8(c) 19.4. Studies to determine optimum shade requirement of cocoa.

This was laid out as an unreplicated observational trial at Vellanikkara in 1979. A total of 1027 cocoa seedlings were planted under the existing rubber canopy is around 25%. Selective thinning of rubber trees were done to provide light intensities of about 25, 50, 75 and 100% in the four observational plots during 1984. Growth characters were recorded during the pre and post experimental period and yield data during the post experimental period and given in Table 10.

Table 10. Growth characters during the pre and post-experimental period and yield data during the post-experimental period of the shade trial plants.

Light Intensity.	Growth characters (mean values in cm)				Mean yield of pods '84 No. of pods/ tree.
	1983 pre-experimental		'84 post-experimental		
	Girth	Canopy spread	Girth	Canopy spread	
25%	13.34	150.24	20.17	241.69	0.74
50%	12.55	183.06	23.01	237.92	2.43
75%	12.42	165.83	20.05	212.51	3.71
100%	15.19	219.88	25.52	265.28	5.80

Maximum girth, canopy spread and yield were obtained in the open condition, there being a steady increase with increasing illumination levels.

5. KADP Ag.8(c) 19.5. Control of insect pests of cocoa
Concluded.

6. KADP Ag.8(c) 19.6 Studies on the management of squirrels infesting cocoa pods.
Concluded.

7. KADP Ag.8(c) 19.7 Investigation on the etiology of fruit drop disease and their control.
No work was done during the period.

8. KADP.Ag.8(c) 19.8. Control measures for pink disease (Cordicium salmonicolor)

No work was done during the period.

9. KADP Ag.8(c) 19.9. Studies on the die-back disease of cocoa - causes and control.

No work was done during the period.

10. KADP Ag.8(c) 19.10 Post harvest microbial deterioration of cocoa.

No work was done during the period.

4.2.2. RESEARCH PROJECTS ON PEPPER:

1. KADP Ag.5(a)19.1 Breeding varieties of pepper with desirable characters.
2. KADP Ag.5(a)19.2 Training and pruning trials on pepper
 - (a) Standardisation of pruning technique in bearing pepper vines.
 - (b) Standardisation of pruning technique in young pepper vines.
3. KADP Ag.5(a) 19.3 Spacing-cum-standard-cum-varietal trial on pepper.
4. KADP Ag.5(a) 19.4 Micronutrient trial on pepper
5. KADP Ag.5(a)19.5 Standardisation of tissue analysis technique in pepper.
- *6. KADP Ag.5(a)19.6 Biology, phenology and bionomics of the pepper pollu beetle(Longitarsus nigripennis)
7. KADP Ag.5(a)19.7 (a) Role of nematodes of the incidence of slow wilt disease of pepper and to find out suitable control measures.
8. KADP Ag.5(a)19.7 Slow wilt disease - Adoption of suitable cultural practices in addition to plant protection measures to rejuvenate slow wilt affected plants.
9. KADP Ag.5(a)19.8a. Studies on fungal pollu (anthracnose) - etiology and nature and extent of damages.
- *10. KADP Ag.5(a)19.8b. Studies on the ecology of fungal pollu

11. KADP Ag.5(a) 19.8c. Effect of prophylatic control measures of quickwilt(stem rot) disease on the control of fungal pollu(anthracnose).disease of pepper.
12. KADP Ag.5(a)19.9a Quickwilt disease of pepper-ecological studies.
- *13.KADP Ag.5(a)19.9b Quickwilt disease of pepper - survey of collateral host Phytophthora palmivora(Butler) especially the weeds and other economic plants usually seen in pepper gardens.
- *14. KADP.Ag.5(a)19.9c Quickwilt disease of pepper - symtomatological studies.

* Concluded projects.

1. Breeding varieties of pepper with desirable characters:

During the period under report the maximum number of open pollinated seeds belonging to different collections available in the germplasm was collected from the Pepper Research Scheme, Vellanikkara and sown in polythene bags. The germination of the seeds was poor and the seedlings are being maintained for further study of yield and other quality characters.

From the previous observations selection no. was included and laid out in the multilocational trial.

2. Training and pruning trials on pepper:-

- (a) Standardisation of pruning technique in bearing pepper varieties.

Owing to the heavy casualty of vines due to the previous years drought and quick wilt disease in spite of prophylatic measures adopted it was not possible to implement the project as sufficient number of healthy and uniform plants were not available.

- (b) Standardisation of training and pruning of young pepper varieties:

As per the technical programme Erythrina standards were used for the experiment and most of them could not

stand the severe drought of 82-83.

However during the period under report both the standards and planting was ~~done~~ once again and the establishment of both was satisfactory. Another draw back is that the plot gets flooded during the rainy season and even after opening out channels some of the plants could not stand the flooding.

3. Spacing-cum-standard-cum-variatal trial on pepper.

The casualty of vines was fairly high in both the Erythrina and gargua standards. Dead teak wood is found to be better than both the other standards. Among the varieties Karimunda showed more mortality rate than Panniyur-1. All observations on growth and yield are being recorded. The averages are being worked out for statistical analysis.

4. Micronutrient trials on pepper.

No work has been started for want of sufficient number of uniform plants.

5. Standardisation of tissue analysis technique in pepper;

Work on the determination of critical nutrient levels is in progress. The analysis of samples collected for this purpose was over and the statistical analysis is in progress.

6. Biology, phenology and economics of the pepper pollu beetle:

Concluded.

7. Role of nematodes on the incidence of slow wilt disease of pepper and to find suitable control measures:

The rooted pepper cuttings were planted in de-nematized soil (in cement tubs). The vines which have attained growth of three years were inoculated on 2nd February 1985 with both nematodes Radopholus similis and Meloidogyne incognita. Observations on symptom development is being

recorded.

In another trial conducted at the Radiotracer Laboratory it was found that inoculation of vines with *Meloidogyne incognita* could affect adversely the uptake of Zn, Mn and K by the vines. (Table 11)

Table 11. Growth and nutrient uptake by black pepper vine (during 8 month growth period of rooted cuttings) following soil inoculation with *Meloidogyne incognita*.

Growth parameter	Inoculated	uninoculated	CD(0.05)
Drymatter(g/plant)	14.10	14.10	NS
No. of leaves per plant	22.33	23.58	NS
*Foliar yellowing index	0.212	0.143	NS
Root dry wt.(g/plant)	1.77	2.218	0.348
Dry wt. of galled roots (mg/plant)	763	119	319
Dry wt. of gall-free roots (g/plant)	1.031	2.098	0.308
Ratio of galled to total root wt.	0.543	0.543	0.094
<u>Nutrient uptake(mg/plant)</u>			
N	223.4	223.9	NS
P	15.58	17.17	NS
K	236.4	309.9	34.4
Ca	293.5	322.2	NS
Mg	99.3	146.7	NS
S	19.2	22.2	NS
Fe	1.81	1.71	NS
Mn	1.44	1.97	0.45
Cu	0.305	0.306	NS
Zn	0.470	0.602	0.110

* Foliar yellowing index is work out at the ratio of the number of leaves showing yellowing to the total no. of leaves on the plant.

8. Slow wilt disease adoption of suitable cultural practices in addition to plant protection measures to rejuvenate slow wilt affected plants.

The nematode population was estimated in 100 ml soil prior and after application. The data showed that nematode population has considerably reduced (Table 12)

Table 12 Nematode population in the different treatments (no. of nematodes/100 ml soil)

Organism	Pretreatment	Population after the 3rd year				
		T ₁	T ₂	T ₃	T ₄	T ₅
<u>Meloidogyne</u>	0-135	39-662	0-3	0-102	0-86	0-8
<u>Rotylenchulus</u>	0-254	6-413	0-29	0-58	0-27	0-31
<u>Helicotylenchus</u>	0-63	3-181	0-23	0-86	0-19	0-23
<u>Radopholus</u>	0-128	0-94	Nil	Nil	Nil	Nil

The reaction of vines in terms of foliar yellowing, die back, leaf drop etc. were recorded. The experiment is now over and data is yet to be analysed.

9. Studies on fungal pollu (anthracnose) - etiology and nature and extent of damages

Fifty standards were randomly marked for assessing the disease incidence. The pathogen was isolated from the diseased parts of the vines. The pathogen was confirmed as Colletotrichum gleosporioides. From the harvested spikes, infected spikes were separated and categorised according to the nature of infection viz. thread infection, early berry infection and late berry infection. Thousand berries from each type of infection has been dried and kept separately the quality and quality loss due to infection. Yield loss in pepper due to fungal pollu infection was worked out. There was no statistical significance in the

in the different treatments tried.(Table 13).

Table 13 Percent spike infection due to fungal pollu caused by Phytophthora palmivora

Treatments	%thread infection	%berry infection	Total infection
T ₁	0.61 (4.48)	12.90 (20.05)	13.51 (21.56)
T ₂	0.64 (4.59)	15.81 (23.42)	16.45 (23.97)
T ₃	1.12 (6.02)	14.36 (22.30)	15.48 (23.19)
T ₄	0.73 (4.90)	15.87 (23.50)	16.60 (24.04)
CD	NS	NS	NS

4.2.3. Research Projects on Cashew:

1. KADP. Ag. 6.19.1 Survey and collection of Superior Genotypes.
2. KADP. Ag. 6.19.1 Genetic Improvement by hybridization and selection.
3. KADP. Ag.6.19.3 Standardisation of vegetative propagation in cashew.
4. KADP. Ag.6.19.4 Nutritional studies in cashew
5. KADP Ag. 6.19.5 Multilocational Trial on orchard management practices(concluded project)
6. KADP. Ag. 6.19.6 Cultural trial
7. KADP. Ag. 6.19.7 Spacing trial
8. KADP. Ag. 6.19.8 Exploration of the feasibility of biological control of Helopeltis.
9. KADP. Ag.6.19.9. Studies on the Control of stem borer (Placaederus ferrugineus) (Concluded Project)

1. Survey and collection of superior genotypes.

No fresh collections of germplasm was attempted during the year for want of planting space. All the collections obtained from various research stations and private farms were maintained and multiplied. A fresh attempt was made to obtain all the species of Amacardium other than the cultivated type from Brazil through the Director, Plant Introduction Division, IARI. Attempts have been made to pool all the germplasm collections maintained at different research stations to one centre at Vellanikkara so that the maintenance of these materials can be entrusted to the main centre of research.

2. Genetic Improvement by hybridization and selection

Hybridization programme in cashew was first initiated during 1981, at this centre. Many of the types maintained here have undersized nuts and poor shelling recovery. A good number of them comes to maturity very late in the season with the result, the harvesting also gets delayed. So the main objectives of the hybridization programmes were to evolve types having bold nut size with high shelling recovery and earliness. With the above objectives in view, 1334 crosses were effected during the year using 40 different parental combination. A total of 314 hybrid nuts were collected for raising in the ensuing season.

Some of the hybrid progenies evolved during March 1981 and March 1982 have started bearing. Many of them were found to possess better yield characteristics as well as bold nut size. The yield data of some promising hybrids are given in Table 14.

Table - 14

Sl.No.	Tree No.	Parents involved in the cross.	Yield of raw nuts 1983-84	Yield of raw nuts 1984-85.	Remarks
1	341	1589x730	0.420 kg.	3.000kg.	
2	347	% "	-	1.895 "	
3	348	" "	0.635	1.565 "	
4	351	1599x745	0.360	3.170 "	
5	354	1859x514	0.425 kg.	3.675 "	
6	355	1599x745	0.530	2.345 "	
7	358	" "	--	1.580 "	
8	366	1859x514	--	1.550 "	
9	364	" "	--	3.830 "	
10	365	1140x855	0.840	1.170 "	
11	368	" "	--	1.195 "	
12	369	1633(selfed progeny)	0.335	1.975 "	
13	376	1140x855	--	1.045 "	
14	377	" "	--	1.460 "	
15	381	" "	--	1.420 "	
16	396	514x1588	0.335	3.290 "	
17	402	574x1588	--	3.020 "	
18	407	730x1589	0.170	2.550 "	
19	408	" "	--	3.035 "	
20.	410	" "	--	2.685 "	

3. Standardisation of vegetative propagation in cashew

Monthly trials on epicotyl grafting, soft-wood grafting and patch-budding were carried out from August 84 to March '85. From the observations recorded it was found that the initial take in epicotyl grafting was very high. But subsequently the percentage went down, and after two months of grafting, the final percentage of success ranged from 5 to 16%. In most of the cases, the scion just below

the graft union rots and the plant dies. Suspecting some fungal infection, the plants were drenched with fungicides. But it could not improve the percentage of success. The results are given in Table 15.

Table 15

Method of propagation.	No. grafted/budded.	Initial take.	No. survived after 45 days.	No. survived after 60 days.	Final take
<u>Aug. '84</u>					
Soft wood grafting	500	349	107	32	14
Inarching	17	15	15	15	15
Epicotyl grafting	301	179	38	13	12
<u>Sept. '84</u>					
Soft wood grafting	440	267	13	10	8
Epicotyl "	215	118	--	--	--
<u>Oct. '84</u>					
Epicotyl grafting	377	298	18	6	6
Inarching	63	48	34	32	32
Patch budding	121	91	1	1	1
<u>Nov. '84</u>					
Patch budding	455	49	14	13	13
Epicotyl grafting	212	18	8	--	--
<u>Dec. '84</u>					
Patch budding	192	33	7	7	7
<u>Jan. '85</u>					
Patch budding	455	76	17	15	15
<u>Feb. '85</u>					
Patch budding	90	15	8	5	5
Epicotyl grafting	445	110	77	51	25
<u>March '85</u>					
Epicotyl grafting	867	490	258	160	138

In general, the percentage of take in epicotyl grafting was more during summer months than other periods of the year.

4. Nutritional studies in cashew

The fertilizer trial on cashew was started in June 1979 using seedling progenies of the type BIA-39-4. Three levels of N viz. 250, 500 and 1000 gm/tree three levels of P viz. 125, 250 and 500 gm/tree and three levels of K viz. 250, 500 and 1000 gms of K/tree are being tried. The growth measurements of the trees as well as yield were recorded. Statistical analysis of the yield data showed that the treatment effects were not significant. The yield of the trees has not come to a steady level yet. Further the treatment plants are of seedling origin and therefore the variability in the plants cannot be completely eliminated.

Another fertilizer trial using air-layers as the treatment plants is in progress. Since all the plants are vegetatively propagated material from one type the variability within the plants is likely to be very small and therefore the treatment effects will be more pronounced. The trees have not reached the bearing stage yet.

In simple fertilizer trials laid out in farmers' fields in different soil types an entirely different levels of NP and K are being tested. The following four levels are under testing with no manuring as the control.

<u>Treatments</u>	<u>N</u>	<u>P₂O₅</u>	<u>K₂O</u>	(g/tree)
1	0	0	0	
2	125	125	125	
3	250	125	125	
4	500	250	250	
5	750	250	500	

Out of the five locations, two are in laterite soils, one each in forest soil and sandy soil. There is also one trial

laid out in laterite soil under irrigated conditions. In this trial the treatments are the same but the effect of irrigation is compared with the unirrigated trees under different levels of fertilization. All the trees have not yet reached the steady bearing age.

The general trend in simple fertilizer trials has been that there is linear response to increased levels of fertilization. The response to K was more in sandy soils than either laterite or forest soils.

5. Multilocation Trial on Orchard Management

The aim of this trial was to identify a suitable intercrop in cashew gardens in the initial five or six years of planting cashew. When once the canopy of the plants develops there will be practically no inter-space left for raising any crop in cashew gardens. The intercrops tried were (1) Lemongrass (2) Tapioca (3) Cowpea followed by horsegram (4) Pine apple and (5) sickle weeding (control). In this study, not only the economics of raising the intercrops but also the effect of the intercrops on the growth and yield of the cashew trees were also tested. It has been observed that pine apple gives the maximum return among the four crops tried. Even though there was no measurable effect on the spread of the trees, it was found that the trees in plots intercropped with pineapple had the maximum height followed by sickle-weeding plot (Control) and cowpea plot, while plots inter-cropped with tapioca and lemongrass had the least height. This shows that raising of intercrops like tapioca and lemongrass has a depressing effect on the natural growth of cashew trees. The same trend was observed in previous years also. The analysis of the yield showed that there was no significant difference among the various treatments.

6. Cultural Trial

The aim of this trial was to fix up a suitable cultural operation that would conserve moisture in cashew gardens



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during the summer. As cashew is grown in rainfed condition, moisture-conservation is an important operation that will affect the growth and yielding ability of the trees. The usual practices followed are mulching, cover cropping etc. The following treatments were tried for preservation of moisture.

1. Sickle weeding
2. Light digging around the trees to a radius of two metres.
3. Light digging and mulching " " "
4. Covering the plant basins with polythene sheets for two metres radius.
5. Cover Cropping.

Besides yield, growth parameters like girth, height, spread of the trees and the moisture level of the soils coming under the different treatments were also compared. The statistical analysis of the yield data and growth data showed no significant difference among the treatments. Soil samples collected from different depths were tested for moisture percentage. It was found that plots where plant basins were covered with polythene sheets, had better moisture conservation than other treatments. This trend was observed in previous years also.

7. Spacing Trial

This study was initiated to find out the optimum spacing for cashew both for seedling progenies as well as clonal progenies. The spacing trial with clonal progenies was laid out during August 1980 using the air-layers of the type K-22-1. A similar trial using seedling progenies of the same type was also laid out in 1982. In all, seven different spacings ranging from 4m x 4m and going up to 12 x 12m. are under comparison. The yield data as well as the growth measurements of all the treatment plants were recorded. Statistical analysis of the data showed that there was no significant difference among the treatments. The trees have not reached the steady bearing age as yet.

8. Exploration of the feasibility of biological control of Helopeltis antonii

This trial was not taken up so far, for want of suitable predators for the pest.

9. Studies on the control of stem borer

The project was concluded and final report sent. (Result was included in the last year's report.)

4.2.4. RESEARCH PROJECTS ON COCONUT

1. KADP Ag.2.19.1 Survey of gardens to select superior genotypes which are high yielding and resistant or tolerant to major pests and diseases.
2. KADP Ag.2.19.2 Evolving high yielding varieties which are tolerant or resistant to different pests and diseases.
3. KADP Ag.2.19.3 Fixing up selection criteria for hybrid coconut seedlings at nursery stage.
4. KADP Ag.2.19.4 Nutritional studies in coconut I. The effect of micronutrients on the yield, growth and disease resistance in coconut.
5. KADP Ag.2.19.5 Nutritional studies in coconut II. Simple fertilizer trials in cultivators' fields under different soil types, both under ~~irrigated~~ irrigated and rainfed conditions.
6. KADP Ag.2.19.6 Response to irrigation, water use efficiency and cost-benefit ratio under limited and ample supply of water.
7. KADP Ag.2.19.7 Determination of pre-potency of hybrid coconuts to produce high yielding progenies.
8. KADP Ag.2.19.8 Assessment of combining ability of dwarf coconuts.
9. KADP Ag.2.19.9 Studies on the sex ratio regulation in Bracon brevicornis.
- *10. KADP Ag.2.19.10 Studies on the sex ratio regulation in bethylids (Perisierola nephantidis)

11. KADP Ag.2.19.11 Studies on the temperature humidity tolerance of the bethylid parasite (Perisiraola nephantidis)
 - *12. KADP Ag.2.19.12 Studies on the evaluation of tachnid parasite (Spogossia bezziana).
 - *13. KADP Ag.2.19.13 Biological control of rhinoceros beetle (Cryctes rhinoceros)
 14. KADP Ag.2.19.14 Survey of the microbial pathogen of the red palm weevil (Rhyncophorus ferruigenius) in endemic areas of the state.
1. Survey of gardens to select superior genotypes which are high yielding and resistant to or tolerant of major pests and diseases.

Survey of coconut gardens was initiated in 1982-83 in Trivandrum and Trichur districts. In addition, gardens in disease affected districts have also been surveyed for super palms. During the year under report a total number of 80 gardens were examined in Alleppey, Ernakulam, Trichur and Palghat districts and six palms were selected making the total to 28. Observations on general performance including the extent of incidence of pests and diseases have been made on the palms already selected. It was found that 12 of the selected palms in Trichur, Ernakulam and Alleppey districts have found to be erratic in bearing consequent to ~~xxxxxi~~ certain defects like severe button shedding inflorescence abortion, general reduction in vigour resulting in leaf distortions and or faccidity. Work is in progress.

2. Evolving high yielding varieties which are tolerant or resistant to different pests and diseases.

The general performance of all the hybrids was satisfactory. Commencement of flowering has been noticed in all hybrid combinations. However, most of the palms exhibited difficulty in the emergence of spathes consequently, spadix emergence was incomplete to varying extent. Most palms showed moderate to high levels of button shedding. Almost all palms have been found to contain relatively a large build

up of mealy bugs against which plant protection measures were taken twice.

3. Fixing up selection criteria for hybrid coconut seedlings at nursery stage.

The performance of the two groups of F1 hybrids of WCT x CDO and WCT x GB which are in the seventh year of planting, was satisfactory. In the first the percentage of palms started flowering till 3/85 was 73 while it was 63 in the latter group. Samhemp was sown and later incorporated in the field. All palms were treated with chemicals against mealy bug and this in turn helped the palms to tide over severe drought and to get rid of termite attack over the bank portion of the stem.

Observations were made on yield and other vegetative characters of the palms in both groups. In T x CDO combination plant No.259 recorded the highest value for collar girth (127 cm) while several plants gave values of 15 for number of leaves produced per year.

In the T x G combination plant No.108 had the maximum number of leaves(17) produced per year. In respect of collar girth the highest value of 123 cm was recorded by plant No.79.

Data on yield and nut characteristics of seedlings that have come to harvest till the end of March 1985 have been examined. In the T x CDO group no.of nuts harvested per palm ranged from 1 to 35, the maximum being in tree No.72. Weight of nut(mean of 3 nuts selected from base, centre and apex portions of the spadix) ranged from 665 to 1950g; highest being in No.349. Mean volume of nut ranged from 1690 go 4000 ml(No 349). Weight of husked nut was the maximum(895g) in tree no 253 and volume(1110ml) in tree no. 331. Weight of copra (fully dried) varied from 23g to 300g maximum in plant no.344.

In T x G combination, maximum nuts(34) was recorded by the tree no.203, the range being 1 to 35; maximum weight per nut(1965g) was in plant no.26 which also showed the

highest wt. of husked nut(995g). Maximum volume of nut (5175ml) was shown by pl no.134 while maximum volume(925) of husked nut was recorded by the plant 262. Weight of kernel ranged from 45 g to 212g, the heaviest being produced by palms 26 and 149.

4. Nutritional studies on Coconut I. The effect of micronutrients on the yield, growth and disease resistance in coconut.

The trial was laid out with three levels each of Zn, B and Mo with and without added organic matter in addition to 2 kg. dolomite and NPK at rates 0.5 kg, 0.34kg 1.2 kg respectively per palm, variety Laccadive Ordinary Growth measurements were recorded. Leaf and soil samples were collected for analysis.

5. Nutritional studies on coconut II - simple fertilizer trial in cultivators fields under different soil types both in irrigated and rainfed conditions.

The experiment aims at finding out economic levels of fertilizers for coconut under rainfed and irrigated conditions. The split-up of trial plots initially started in four districts in the State are Trivandrum-10, Malappuram 9, Kozhikode 6 and Cannanore-4. Five of the total 29 were later abandoned due to change of ownership of the plots and other technical reasons. The experiments were top dressed with fertilizers as per schedule. Soil samples were collected and processed for analysis from plots in Kozhikode and Cannanore districts. The trials are in progress.

6. Response to irrigation, water use efficiency and cost benefit ratio under limited and ample supply of water.

This trial was not laid out in cultivators fields as no suitable plots were made available from cultivators. However one trial was initiated at the RARS, Pattambi.

7. Determination of pre-potency of hybrid coconuts to produce high yielding progenies.

Seedlings from 30 F₁ progenies representing six family groups were transplantation at the KAU Livestock Farm, Thiruvazhankunnu in 1981. The general stand and growth of all seedlings were satisfactory. Regular cultural and

manurial practices were carried out as per schedule. Gap filling was also attended to using WCT Seedlings. The trial is in progress.

8. Assessment of combining ability of dwarf coconuts.

The objective of the study is to select dwarf coconut palms that possess general combining ability as well as high specific combining ability. Seventy four crosses between 16 WCT selected palms and eight desirable dwarf palms belonging to Chowghat Dwarf Yellow(CDY), Gangabondam(GB), Chowghat Dwarf Green(CDG), Malayan Dwarf Orange(MDO), Malayan Dwarf Green(MDG), Malayan Dwarf Yellow(MDY) Andaman Dwarf(AD) and Laccadive Dwarf(LD) were effected in 1979 and their seedlings 409 in number, were transplanted at the KAU Main Campus in 1981. Among these a total of 45 seedlings died of drought in 1983 and 85 and incidence of pests and diseases. Gap filling will be done as soon the specific combinations are made available from the RARS Piliccode.

Observations on growth attributes were collected during the year under report. The performance of the hybrids was satisfactory. The highest mean values of collar girth (61.5 cm) and plant height (4.2m) were recorded by combinations of G 34xMDO and G 25xCDY respectively while mean leaf number per year was the maximum(9) in three hybrids viz. G 193 x LD, G 205 x GB and G 24 x LD.

Projects 9, 10, 11 were concluded and the results were presented in the Annual Report for the year 1980-81.

12. Studies on the evaluation of Tachnid parasite (Spogossia lezziana)

The study was not taken up for want of the exotic parasite.

13. Biological control rhinoceros beetle(Oryctes rhinoceros) and

14. Survey of the microbial pathogen of the red palm weevil (Rhynophorus ferruginus) in endemic areas of the State.

Projects KADP Ag 2.19.13 and 14.14 have been transferred to the Insect Pathology Unit, College of Agriculture, Vellayani.

5. FINANCIAL ACHIEVEMENT

Out of a total budget provision of Rs,26,01,000/- an amount of Rs.9,12,667.54 has been spent during the year. The details are furnished below:

Head of Account : IV b(xiv) KADP Research & Training
by KAU.

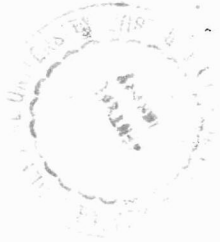
Particulars	Budget Estimate for 1984-85 Rs.	Actual Expenditure for 1984-85. Rs.
I. Salaries(Pay, DA., C & OA)	3,40,000.00	3,85,026-35
II. T.A.	12,000.00	9,575-48
III. Recurring Contin- gencies.	3,43,000.00	4,00,525-13
IV. Non-recurring:		
(i) Building	6,000.00	5,930-82
(ii) Equipment	*18,00,000.00	95,248-31
(iii) Training Overseas.	1,00,000.00	16,361-45
Total	26,01,000.00	9,12,667-54
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* The amount not received from the Government.

The Progressive Expenditure under KADP - Research and Training for the years 1977-78 to 1984-85

Items	1977-78 (Rs)	1978-79 (Rs)	1979-80 (Rs)	1980-81 (Rs)	1981-82 (Rs)	1982-83 (Rs)	1983-84 (Rs)	1984-85 (Rs)
Salaries & TA	-	120889.28	191327.80	230844.92	273583.10	281958.79	346878.91	394601.83
<u>Contingencies:</u>								
Recurring	16376.24	121547.25	204147.69	218760.66	274066.43	263028.61	393337.30	400525.13
Non-recurring	357003.38	2943593.00	604003.99	828360.84	1130240.85	382631.88	186795.76	117540.58
Total	373379.62	3186029.53	1003479.48	1277966.42	1677890.38	927169.28	927011.97	912667.54

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Gopalakrishnan
ASSOCIATE DEAN

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