

RP-88

13

Preprint from Conference on Cocoa & Coconuts, 1971

CACAO UNDER PALMS

by

K. Shama Bhat & K.V. Ahamed Bavappa

Central Plantation Crops Research Institute, Kasaragod, Kerala State, India

SUMMARY

There was no adverse affect on the performance of either areca or cacao in a mixed plantation during the period of study. The performance of cacao and coconut is also promising. The root spread of areca and cacao is restricted in the early years with the maximum concentration confined to a core of 60 cm radius and 50 cm depth. The possibility of raising cacao in the normally spaced coconut and arecanut plantations has been discussed.

INTRODUCTION

Cacao beans are imported to India to meet the country's requirement of cacao and chocolate industry, which at present consumes about 700 to 1 000 tons of beans per annum (Wood, 1964). The environmental conditions of rainfall, shade etc. required for the large scale cultivation of cacao as a monocrop are limited to a few scattered areas of South India. Even in these areas, distribution of rainfall was found to be the limiting factor. Arecanut (*Areca catechu*) to a considerable extent, and coconut (*Cocos nucifera*) on a limited scale, are raised as irrigated crops in South India. The shade, soil moisture and microclimate existing in these gardens seemed to satisfy the requirements of cacao. Exploratory trials were therefore taken up at the Central Plantation Crops Research Institute to raise the crop both as a pure crop and as a mixed plantation with arecanut and coconut. Preliminary results obtained are discussed in this paper.

REVIEW OF LITERATURE

Urquhart (1961) reported that in Ceylon cacao has been planted among rubber and in Papua and New Guinea with coconut without any evidence of competition between cacao and coconuts. Tam Tai Kin (1968) reported that coconut yields had not been reduced by the cacao and, in fact, claimed that coconut yields were better where cacao has been underplanted. Rodrigo and Mangabat (1964) stated that, in the Philippines, the yield from a trial planting of cacao under coconuts ranged from 1.5 to 3.0 kg of dry beans per tree per year giving an added gross return of P. 2 400 to the estimated income of P. 1 500 a year from coconuts alone. Blencowe (1968) discussed the prospects of growing cacao under rubber in Malaya. According to him shade-tolerant cacao could be established as a system of permanent mixed cropping with rubber. McCulloch (1968) reported that initial growth of cacao under nine-year-old and older oil palms was good, but in a high stand of cacao the combined shade of the cacao and the oil palms was too heavy for optimum yields, particularly after the third year. Bhat and Leela (1968) suggested that on the west coast of India cacao is likely to go well with arecanut palm as a mixed crop.

MATERIAL

Mixed plantings of arecanut and cacao and coconut and cacao were made at the Central Plantation Crops Research Institute, Kasaragod and at its Regional Station, Vittal. The garden at Vittal was planted in 1964 with arecanut seedlings of identical age under three systems (i) arecanut and cacao (variety-Criollo) at 50:50, (ii) areca as pure crop and (iii) cacao along the borders of an areca garden. The trees were planted in Quincunx layout with a spacing of 4 m × 4 m. The pattern of root spread was studied on one set of adjacent cacao and areca trees selected in the plot with cacao and areca at 50:50 following the procedure described by Bhat and Leela (1969). The areca palms as well as the cacao trees were manured with 100 g N, 40 g P₂O₅ and 140 g K₂O per plant. They were also irrigated during hot, dry weather months from December to May each year.

The cacao under coconut was established in an existing coconut plantation, 7.6 m spacing, planted in 1955-56 under three systems, (1) cacao as single hedge at a spacing of 3.8 m apart, (2) cacao as double hedge 3.8 m between plants in the row and 2.4 m between rows in triangle and (3) control—no cacao. Cacao was manured at the rate given above while coconut received 0.5 kg N, 0.32 kg P₂O₅ and 1.2 kg K₂O per palm per year.

RESULTS

1. *Flowering and yield*: Under arecanut, cacao trees commenced to flower 14 months after planting and the first crop of mature fruits was harvested 13 months later. The arecanut palms commenced to flower three years after planting in all the treatment plots. The results of observations made are summarised in *Table 1*. It can be seen that cacao had no adverse effect on the yield of arecanut. In fact there appears to have been some beneficial effect as indicated by the higher yield of areca in the plot where there was mixed planting (50:50). The cacao planted as a border crop suffered due to sunscorch. The cacao planted under coconut flowered 10 months after planting. It has yet to come to full bearing.

2. *Pattern of root spread*: The distribution of roots in the mixed planting of cacao and arecanut (expressed as dry weight in grammes) at different distances from the centre of the trees is given in *Table 2*. It can be seen that 81.19% of all roots and 55.10% of fine roots (less than 4 mm) of cacao are concentrated within 60 cm radius from the centre of the tree. In the case of arecanut 78.95% of all roots and 72.22% of fine roots are concentrated within 60 cm radius from the centre of the palm. The distribution of total and fine roots at different depths is given in *Table 3* from which it can be seen that the cacao roots have extended to a depth of 1.5 m and those of areca to 1.8 m. The maximum concentrations of roots is within the top 50 cm. The weight of roots produced in this zone, per unit area, is much greater with areca than it is with cacao; more than five times greater in the case of fine roots.

Table 1. Flowering and yield—Areca and Cacao, mixed garden

Year	Treatment	Cacao Mean pods/ tree	Areca		
			Trees flowered %	Mean No. of nuts per tree	Mean weight (kg) of nuts per tree
1967-68	1	21.8	52.8	—	—
	2	—	44.6	—	—
	3	4.6	37.6	—	—
1968-69	1	23.2	88.9	—	—
	2	—	82.1	—	—
	3	4.9	75.0	—	—
1969-70	1	81.7	100.0	95.5	3.4
	2	—	100.0	42.7	1.6
	3	30.9	100.0	28.7	1.2
1970-71	1	63.7	100.0	225.2	7.7
	2	—	100.0	169.5	6.8
	3	35.7	100.0	125.4	4.4

Treatment: 1. Areca and Cacao (50:50).
 2. Pure plantation of areca.
 3. Cacao as a border crop in areca garden.

Root studies in the mixed planting of cacao and coconut have not been made as the cacao plants are too young for this purpose.

DISCUSSION

The results show that the yield per tree of areca is likely to be more when it is grown mixed with cacao (50:50) than when in pure stand. However, it must be remembered that the total number of areca trees in the mixed garden is only half that in a pure planting. The yield of areca per unit area is 33.4% less. Nevertheless the value of this loss is expected to be made up by the yield of the companion crop, cacao.

The nutrient requirements of the two crops when grown mixed has yet to be studied. Tam Tai Kin (1968) has reported that cacao has significant effects on coconut palm nutrition. According to him levels of leaf nitrogen and phosphorus were significantly lower in palms with underplanted cacao, whilst that of magnesium was significantly higher in the same plots. McCulloch (1968) stated that levels of potassium that are adequate for the oil palms may be high enough to depress the yield of the cacao. In the case of a mixed plantation of areca and cacao it is likely that the accumulating cacao leaves may benefit the areca to some extent. Weed growth is very much less in a mixed garden than in a pure plantation of areca.

Table 2. Distribution of roots at different distances from the tree

Distance from centre of stem cm	Cacao					Areca						
	Total weight of all roots (gm)	% All roots	Fine roots (gm)	% Fine roots	Thick roots (gm)	% Thick roots	Total weight of all roots (gm)	% All roots	Fine roots (gm)	% Fine roots	Thick roots (gm)	% Thick roots
0-10*												
11-35	344.00	48.42	51.00	28.54	293.10	55.11	970.16	60.01	496.81	50.02	473.35	75.93
36-60	232.76	32.77	47.46	26.56	185.30	34.85	306.19	18.94	220.44	22.20	85.75	13.76
61-85	68.22	9.60	23.97	13.42	44.25	8.32	133.01	8.23	104.46	10.52	28.55	4.58
86-110	28.94	4.07	20.79	11.64	8.15	1.53	87.34	5.40	70.37	7.09	16.97	2.72
111-135	19.26	2.71	18.26	10.22	1.00	0.19	45.55	2.82	34.54	3.48	11.01	1.77
136-160	10.37	1.46	10.37	5.80	—	—	29.97	1.85	26.97	2.72	3.00	0.48
161-185	4.17	0.59	4.17	2.33	—	—	16.66	1.03	14.66	1.48	2.00	0.32
186-210	1.70	0.24	1.70	0.95	—	—	12.33	0.76	10.68	1.08	1.65	0.26
211-235	0.59	0.08	0.59	0.33	—	—	10.33	0.64	9.28	0.93	1.05	0.17
236-260	0.37	0.05	0.37	0.21	—	—	4.99	0.31	4.94	0.50	0.05	0.01
Total	710.38		178.68		531.70		1616.53		993.15		623.38	

* Allowance for the girth of stem from centre.

Table 3. Distribution of roots at different depths

Depth cm	Cacao				Areca							
	Total weight of all roots (gm)	% All roots	Fine roots (gm)	% Fine roots	Thick roots (gm)	% Thick roots	Total weight of all roots (gm)	% All roots	Fine roots (gm)	% Fine roots	Thick roots (gm)	% Thick roots
0-10	59.60	8.39	44.25	24.76	15.35	2.89	501.90	31.05	326.25	32.85	175.65	28.18
11-20	449.22	63.24	39.52	22.12	409.70	77.05	403.55	24.96	239.65	24.13	163.90	26.29
21-30	67.86	9.55	20.26	11.34	47.60	8.95	190.49	11.78	86.59	8.72	103.90	16.67
31-40	62.55	8.81	20.25	11.33	42.30	7.96	137.57	8.51	80.07	8.06	57.50	9.22
41-50	30.69	4.32	17.79	9.96	12.90	2.43	121.32	7.51	65.72	6.62	55.60	8.92
51-60	12.07	1.69	9.97	5.47	2.10	0.39	74.40	4.60	47.45	4.78	26.95	4.32
61-70	11.42	1.61	9.72	5.44	1.70	0.32	48.05	2.97	33.55	3.38	14.50	2.33
71-80	6.38	0.90	6.33	3.54	0.05	0.01	40.84	2.53	33.54	3.38	7.30	1.17
81-90	5.11	0.72	5.11	2.86	—	—	36.59	2.26	28.49	2.87	8.10	1.30
91-100	3.48	0.49	3.48	1.95	—	—	31.77	1.97	24.57	2.47	7.20	1.15
101-110	0.86	0.12	0.86	0.48	—	—	16.03	0.99	13.66	1.38	2.37	0.38
111-120	0.56	0.08	0.56	0.31	—	—	6.55	0.41	6.25	0.63	0.30	0.05
121-130	0.41	0.06	0.41	0.23	—	—	2.23	0.14	2.12	0.21	0.11	0.02
131-140	0.16	0.02	0.16	0.09	—	—	2.47	0.15	2.47	0.25	—	—
141-150	0.01	—	0.01	0.01	—	—	1.81	0.11	1.81	0.18	—	—
151-160	—	—	—	—	—	—	0.84	0.05	0.84	0.08	—	—
161-170	—	—	—	—	—	—	0.10	0.01	0.10	0.01	—	—
171-180	—	—	—	—	—	—	0.01	—	0.01	—	—	—
Total	710.38		178.68		531.70		1616.52		993.14		623.38	

Study of the pattern of root spread shows that the maximum concentration in both is confined to a core of 60 cm radius and 50 cm depth from the base of each tree leaving a minimum gap of 1.5 m between cacao and arecanut trees not fully utilised by the roots of these plants. It will thus be possible to plant cacao in arecanut and coconut plantations spaced normally so that the land utilisation will be much more efficient. Extensive field experiments in this direction have already been laid out.

Even though the period of observation of cacao under coconut has been short, indications are that cacao and coconut go well together under irrigated conditions.

REFERENCES

- BHAT, K.S. & LEELA, M. (1968). Cacao and arecanut are good companions for more cash. *Indian Fmg.* 18 (4): 19-21.
- BHAT, K.S. & LEELA, M. (1969). The effect of density of planting on the distribution of arecanut roots. *Trop. Agr., Trinidad* 46 (1): 55-61.
- BLENCOWE, J.W. (1968). Cocoa growing under rubber: The prospects. *Cocoa and coconuts in Malaya*. Proceedings of a symposium held in Kuala Lumpur, Sept. 1967, pp. 57-60. Kuala Lumpur: The Incorporated Society of Planters.
- MCCULLOCH, G.C. (1968). Growing cocoa under oil palms. *Ibid.*: 61-67.
- RODRIGO, P.A. & MANGABAT, C.P. (1964). Cacao proves to be a paying intercrop in coconut gardens. *Coconut Bull.* 18 (5): 185-190.
- TAM TAI KIN (1968). Effects of cocoa underplanting on growth and yield of coconut. *Cocoa and Coconuts in Malaya*. Proceedings of a Symposium held in Kuala Lumpur, Sept., 1967, pp. 50-56. Kuala Lumpur: The Incorporated Society of Planters.
- URQUHART, D.H. (1961). *Cocoa*. London: Longmans, Green & Co., Ltd.
- WOOD, G.A.R. (1964). *Cacao growing in India*. Cadbury Brothers Ltd., Bournville.