COCOA UNDER PALMS

by

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SUMMARY

Interplanting cocoa with areca or coconut palms had no adverse effect on the performance of either crop during the period of study. The root spread of areca and cocoa 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 cocoa in normally-spaced coconut and arecanut plantations is discussed.

INTRODUCTION

Cocoa beans are imported into India to meet the requirement of the country's cocoa and chocolate industry, which at present consumes 700–1 000 tons of beans per annum (Wood, 1964). The environmental conditions of rainfall, shade, etc. required for the large-scale cultivation of cocoa as a monocrop are limited to a few scattered areas in Souh India. Even in these areas, rainfall distribution is a 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 conditions in these holdings seem to satisfy the requirements of cocoa. Exploratory trials were therefore begun at the Central Plantation Crops Research Institute to raise the crop both as a pure crop and in a mixed planting with arecanut and coconut. The preliminary results obtained are discussed in this paper.

REVIEW OF LITERATURE

Urquhart (1961) reported that in Ceylon cocoa has been planted among rubber and in Papua and New Guinea with coconut without any evidence of competition between the two crops. Tam Tai Kin (1968) reported in Malaysia that coconut yields were not reduced by the cocoa, and claimed that coconut yields were better where cocoa had been underplanted. Rodrigo & Mangabat (1964) stated that in the Philippines the yield from a trial planting of cocoa under coconuts ranged from 1.5–3.0 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 cocoa under rubber in Malaya, and suggested that shade-tolerant cocoa could be established on a system of permanent mixed cropping with rubber. McCulloch (1968) reported that the initial growth of cocoa under 9-year-old and older oil palms was good, but that in a high stand of cocoa the combined shade of the cocoa and palms was too heavy for optimum yields, particularly after the third year. Bhat & Leela (1968) suggested that on the west coast of India cocoa is likely to grow satisfactorily under arecanut palms in a mixed planting.

MATERIALS

Mixed plantings of arecanut and cocoa, and coconut and cocoa, 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 cocoa (variety Criollo) in equal numbers per acre, (ii) areca as a pure crop and (iii) cocoa 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 area of adjacent cocoa and areca trees selected in treatment (i), following the procedure described by Bhat & Leela (1969). The areca palms as well as the cocoa trees were manured with 100 g N, 40 g P_2O_5 and 140 g K_2O per plant. They were irrigated during the hot, dry months from December to May each year.

The cocoa under coconut was established in an existing coconut plantation, 7.6 m spacing, planted in 1955–56 under three systems: (i) cocoa as a single hedge with a within-row spacing of 3.8 m, (ii) cocoa as a double hedge with 3.8 m between plants in the row and 2.4 m between the rows and (iii) control (no cocoa). Cocoa was manured at the rate given above, while coconut received 0.5 kg N, 0.32 kg P_2O_5 and 1.2 kg K_2O per palm per year.

RESULTS

Flowering and yield: Under arecanut, cocoa trees commenced to flower 14 months after planting, and the first crop of mature fruits was harvested 13 months later. The arecanut palms began to flower three years after planting in all treatments. The observations on growth are summarised in *Table 1*. It can be seen that cocoa 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 inter-planted plot (treatment (i)). The cocoa planted as a border crop suffered from sunscorch. The cocoa planted under coconut flowered 10 months after planting, and has yet to come to full bearing.

Pattern of root spread: The distribution of roots in the mixed planting of cocoa and arecanut (expressed as dry weight in g) at different distances from the centre of the trees is given in *Table 2*. It can be seen that 81% of all roots and 55% of the fine roots (less than 4 mm) of cocoa are concentrated within 60 cm of the tree. In the case of arecanut, 79% of all roots and 72% of the fine roots are within this radius. The distribution of total and fine roots at different depths is given in *Table 3*, from which it can be seen that the cocoa roots have extended to a depth of 1.5 m and those of areca to 1.8 m. The maximum concentration of roots lies within the top 50 cm of soil. The weight of roots produced in this zone, per unit area, is much greater with areca than it is with cocoa—more than five times greater in the case of fine roots. Root studies in the mixed planting of cocoa and coconut have not been made as the cocoa plants are too young.

Table 1. Flowering and yield in a mixed garden of areca and cocoa

Year	Treatment	Cocoa 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 cocoa in equal proportions.
2. Areca alone.
3. Cocoa as a border to an areca garden.

DISCUSSION

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

The nutrient requirements of the two crops when grown together have yet to be studied. Tam Tai Kin (1968) has reported that cocoa has significant effects on coconut palm nutrition; he found that levels of leaf nitrogen and phosphorus were significantly lower in palms with underplanted cocoa, whilst that of magnesium was significantly higher in the same plots. McCulloch (1968) stated that levels of potassium adequate for oil palm may be high enough to depress the yield of cocoa. In the case of a mixed plantation of areca and cocoa it is likely that the accumulating cocoa 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.

A study of the pattern of root spread shows that the maximum concentration in both crops is confined to a core of 60 cm radius and 50 cm depth from the base of each tree, leaving a gap of at least 1.5 m between the cocoa and arecanut trees which is not fully utilised by their roots. It will thus be possible to plant cocoa

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

Distance from centre of stem (cm)	Cocoa						Areca					
	Total weight of all roots (g)	All roots (%)	Fine roots (g)	Fine roots (%)	Thick roots (g)	Thick roots (%)	Total weight of all roots (g)	All roots (%)	Fine roots (g)	Fine roots (%)	Thick roots (g)	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	

Table 3. Distribution of roots at different depths

Depth (cm)	Cocoa						Areca					
	Total weight of all roots (g)	All roots (%)	Fine roots (g)	Fine roots (%)	Thick roots (g)	Thick roots (%)	Total weight of all roots (g)	All roots (%)	Fine roots (g)	Fine roots (%)	Thick roots (g)	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	

in normally-spaced arecanut and coconut plantations, with the result that land utilisation will be more efficient. Extensive field experiments in this direction have already been laid out.

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

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