PLANT COMPETITION IN COCOA + ARECA MIXED CROPPING SYSTEM

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ABSTRACT

Intra and inter component competition in *Cocoa* + Areca *mixed* cropping *system were studied using inverse polynomial model* of *the form* $Wc^{-1} = Ac + Bcc\ Pc + Bca$ Pa, *where* Pa. *Pc are plant* densities of two crops *'a' and* 'c', *Wc is the mean yield* per *plant of* crop *c, Bcc and Bca me intra and inter component competition coefficient and* Ac is *the* intercept. *The fitted models* to the *pooled* yield *data of cocoa and arecanut* for *different growth* periods *showed that* in *the case* of *cocoa,* the *main* source of *competition* is intra *component* com-*petition* and *the inter component* competition is *significant* only during 3rd *to 6th* year of *planting whereas* in *arecanut* infer *component competition* was significant *during 11th to 14th year of planting and* in *other periods both intra and inter* component *competition coefficient were not significant.*

INTRODUCTION

In India cocoa was introduced in early sixties as a mixed crop in arecanut gardens since areas with environmental conditions, rainfall, shade, etc., required for large scale cultivation of cocoa as a mono-crop in our country were limited. Bhat and Bavappa (1972) reported that cocoa could effectively be grown in combination with arecanut and coconut to increase the returns per unit area. In southern parts of India arecannt to a large extent and coconut to a limited xale are raised as irrigated crop. The shade, soil moisture and microclimatic conditions prevailed in these plantations seemed to satisfy the requirement of cocoa, and therefore, now it is a popular mixed crop both in coconut and arecanut gardens. Though there have been many investigations to study the plant competition both in, pure and mixed cropping system in several crop species (Donald 1958, Ford 1975, Mead, 1979, Williams 1962), no such information is available in cocoa and arecanut. Hence an attempt has been made to study the intra and inter (within and between) component competition in cocoa + areca mixed cropping system.

MATERIALS AND METHODS

The data of cocoa + areca mixed cropping experiment available at Central Plantation Crops Research Institute, Regional Station, Vittal. India was utilized. The experiment had been laid out in 6 × 2 assymmetrical factorial design with six spacing treatments two manurial levels and four replications The different spacing consists of :

S_1 : both arecanut and cocoa at 2·7m×2·7m (1372 plants/ha.)

S_2 : arecanut at 2·7m×2·7m (1372 plants/ha) and cocoa at 2·7m×5·4m (686 plants/ha.)

S_3 : areca at 2·7m×2·7m (1372 plants/ha) and cocoa at 5·4m×5·4m (343 plants/ha)

S_4 : both arecanut and cocoa at 3·9m×3·9m (657 plants/ha).

S_5 : both arecanut and cocoa at 3·3m×3·3m (918 plants/ha).

S_6 : arecanut at 1·8m×5·4m (1029 plants/ha) and cocoa at 3·6m×5·4m (514 plants/ha).

Both cocoa and arecanut were planted during the year 1970. The area under plantation were irrigated uniformly during the dry weather period from last week of November to April on the onset of rains each year and normal pruning were carried out for the the cocoa plants. Flowering of cocoa and arecanut started at 2nd and 4th year respectively of planting. Since the regular bearing of cocoa started at

:ar and arecanut at 7th year of planting, the yield data of cocoa from 1972 to 1988 and that of arecanut from 1976 to 1988 were considered for the present study. The effects of manuriai treatments and replications were eliminated from tie yield by normal methods. To reduce the yearly fluctuations of yield due to weather factors the data were grouped into four year periods.

To work out intra and inter component competition coefficient inverse polynomial model suggested by Wright (1981) of the form $Wc^{-1} = Ac + Bcc\ Pc + Bca\ Pa$ were fitted to the pooled yield data of cocoa and arecanut (Table 1 and 2) where. Pa, Pc are plant densities 'inverse of the area required for a particular plant) of the two crops 'a' and 'c', Wc^{-1} is the mean yield/plant of crop 'c', Bcc and B ca are intra and inter component competition coefficients and Ac is the intercept. Ratio of inter to intra component competition coefficient were worked out for comparison. Mean yield/plant/year of both cocoa and arecanut were also found for different spacings and over different growth periods (Table 3) to see the actual yield variation.

RESULTS AND DISCUSSION

The fitted models for different periods (table 1 & 2) showed that the R^a values were significant in the cose of cocoa yield whereas it was very low in arecanut, probably due to the absence of densities high enough to lead competition.

In the case of cocoa yield, the main source of competition at all periods was the intra component competition 'Bcc'. The intercomponent competition coefficient 'Bca' was significant only at the initial period 1972-1976 (i.e., 3rd to 6th year cf planting). During this period the heigtt of arecanut crown and cocoa canopy is almost same and probably this leads to competition between cocoa and arecanut for space. As the plant grows, the rate of increase of height is more in arecanut compared to cocoa (Bhat 1983). After seventh year of planting the entire crown of arecanut palms will be above the level of cocoa canopv and as a result the inter component competition has reduced considerably. This is reflected on the competition ratio also (Table 1), which was decreasing as the plant grows. These results showed that the present range of arecanut densities (657-1372 nalms/ha) had no significant effects on :he average yield of cocoa, except in the initial period.

It can be observed from (Table 3) that in spacings S_1 to S_3 where the arecanut density is constant, the average yield/plant/year of cocoa increase as the density of cocoa decreases, whereas in S_5 both cocoa and arecanut density is higher than that of S_4, but the average yield/plant/year of cocoa is higher in S_5 than S_4 excent during 1972-76. This indicates that. to a certain extent arecanut which is giving shade in the cocoa garden has a positive effect on the yield of cocoa rather than adverse effect. Alvim nnd Alvim (1980) and Owusu (1980) have also reported that some degree of shading was beneficial to cocoa.

The model dots not fit for the yield data of arecanut (Table 2) mainly due to the absence of densities high enough to lead competition. The inter component competition was significant only during 1980-84 (Table 2) and in other periods both intra and inter component competition coefficient were not significant.

The non-significant of the inter component competition coefficient in the case of both arecanut (except during 11th and 14th year of planting: and cocoa indicates that cocoa and arecanut can effectively be grown in combination and the introduction of one crop will not affect the yield of other crop.

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TABLE 1

Inverse polynomial competition model fitted for cocoa

Period	Ac	Bcc	Bca	R^2	Bca/Bcc
1972-76	—0·02	0·42**	0·22	0·49**	0·52
1976-80	—0·01	0·21**	0·09	0·42**	0·43
1980-84	—0·01	0·28**	0·07	0·33**	0·25
1984-85	0·00	0·14**	0·02	0·40**	0·14

**Significant at P= 0.01.

TABLE 2

Inverse polynomial competition —model fittfd for arecanut

Pwiod	Ac	Bcc	Bca	R^2	Bca/Bcc
1976-80	0·02	0·06	0·43	0·04	7·17
1980-84	—0·01	0·29	0·40**	0·21**	1·38
1984-88	0 02	0 03	0·05	0 07	1 67

"'Significant at P-0.01

TABLE 3

Average yield/plant /year (wet weight in kg) of cocoa and arecanut for differentgrowth periods

Period	Crop	Spacings					
		S1	S2	S3	S4	S5	S6
1972-76	Arecanut	0·06	0·07	0·57	0·47	0·17	0·37
	Cocoa	4·57	8·96	10·09	11·09	9.54	11·17
1976-80	Arecanut	3·40	3·45	5·10	5·39	3·57	4·20
	Cocoa	9·65	19·48	26·47	20·11	23·23	27·75
1980-84	Arecanut	4·57	5·43	7.10	9·48	5·86	6·66
	Cocoa	7·82	17·42	25.11	15·59	16·51	20.38
1984-88	Arecanut	10·05	10·95	10·79	12·24	9·72	10·90
	Cocoa	10·71	17·70	25·66	16·97	18·73	22.35