

# PERFORMANCE OF ELITE COCOA CLONES UNDER COCONUT IN DOUBLE HEDGE SYSTEM OF PLANTING

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## Introduction

Cocoa (*Theobroma cacao* L.) is commercially grown under palms in Asia-Pacific region. Multipurpose trees like Arecanut (Shama Bhat and Bavappa, 1972; Sujatha *et al.*, 2011), Coconut (Nelliath *et al.*, 1974; George Thomas *et al.*, 2010), Rubber (Blencowe, 1968) and Oil Palm (Reddy and Suresh 2009) are used as shade trees in Malaysia, India, Papua New Guinea and Brazil for cocoa. Wide price fluctuations of coconut market in Malaysia, Sri Lanka and Indonesia leads to identification of alternate crop and found cocoa as compatible and profitable intercrop in coconut garden which, suppressed the weed growth, enriched the environment and improved the coconut yield as well (Recter *et al.*, 1972; Liyange *et al.*, 1986; Mialet *et al.*, 2001; Pushpakumara *et al.*, 2011). In India, state of Andhra Pradesh stands first in cocoa area with 16,969 ha followed by Kerala and Tamil Nadu (DCCD, 2011) and most of these gardens are under coconut. The rising demand in chocolate industry has encouraged farmers to cultivate more cocoa. CPCRI, during 1971 to 1978 research on single and double hedge system of planting in coconut gardens which was found to be highly beneficial and remunerative (Nelliath, 1974). Similarly Kerala Agriculture University also recommended cocoa under coconut (Vikraman Nair *et al.*, 2000). But there was limited work on evaluation on cocoa clones in different cropping systems. Hybrid trials under Arecanut (Vivek Bhat, 1999) conducted by CPCRI identified few elite clones which are included in this study, to

identify best clones suitable for coconut canopy under double hedge system.

## Materials and Methods

Nine elite clones selected from progeny trials were multiplied as grafts and planted in a double row system of planting at a distance of 2.7 m x 2.7 m between two rows of coconut cultivar Laccadive Ordinary Tall spaced at 7.5 m x 7.5 m in the year 2002 at CPCRI, Regional Station, Vittal in Karnataka. Experiment was replicated thrice with 6 trees per block in a randomized block design. Fertilizers, drip irrigation schedules and intercultural operations were practiced as per the recommendations to both the crops. Ten year old cocoa clones were observed for their morphological, yield and bean characteristics. Plant height, girth, no. of branches, canopy area, no. of pods/ tree/ year, pod weight, no. of beans/ pod, single dry bean weight, dry bean yield/ tree/ year, shell and fat contents of beans were documented and statistically analysed with WINSTAT software.

## Results and Discussion

The growth performance of cocoa clones grown under coconut in double hedge system was assessed and it differed significantly between clones (Table 1). Height of clones ranged from 2.85 to 7 m and girth was the maximum (41.5 cm) in the clone VTLCP-1 followed by VTLCP-22. Vigour of cocoa, in general is estimated from the girth of stem in clonal trees and 5 clones exhibited good vigour in the dense planting system. Number of branches ranged from 8.93 to 12.6.

Canopy area was the highest in VTLC-22 with 18.7 m<sup>2</sup> and the lowest (10.8 m<sup>2</sup>) in VTLC-17 which was pruned systematically to maintain a cone shaped canopy. The clone VTLC-22 had the maximum height, branch numbers, canopy area and exhibited high vigour as well. VTLC-17 was considerably with reduced growth habits. Similar trend was observed in these clones under arecanut also (Elain Apshara *et al.*, 2008).

**Table 1.**

**Growth performance of elite clones under coconut**

S. No.	Clones	Height (m)	Girth (cm)	Branch No.	Canopy area (m <sup>2</sup> )
1	VTLC-1	3.48	41.5	12.1	17.8
2	VTLC-7	3.30	38.0	11.6	17.3
3	VTLC-8	2.98	36.2	10.3	14.8
4	VTLC-9	3.24	36.4	11.7	15.5
5	VTLC-17	2.85	39.8	8.93	10.8
6	VTLC-18	3.32	39.6	9.19	16.9
7	VTLC-22	3.67	40.0	12.6	18.7
8	VTLC-23	3.22	33.6	12.1	15.0
9	VTLC-1	2.88	32.2	11.1	11.4
	SEd	0.17	1.85	1.24	1.51
	CD	0.36	3.93	2.64	3.21

In this experiment, number of pods produced was compiled over five harvests accounting only the healthy pods. The elite clones VTLC-18, VTLC-1 and VTLC-22 yielded high (70.3, 62.3 and 61.2 pods/tree/year). Pod and bean characters are given in Table 2. Pod weight among clones ranged from 320.5 to 485.2 grams. Six clones weighed more than 350 grams and all clones recorded >35 number of beans which is desirable. Beans were fermented for one week, dried and observed for single dry bean weights. Only 4 clones recorded >1.0 g dry bean weight and VTLC-22, VTLC-18 and VTLC-1 ultimately had high dry bean yields of 2.87, 2.85 and 2.54 kg dry beans/ tree/ year. In the industrial point of view beans of all clones come under the favourable range of 10-15% in shell contents and VTLC-22 and VTLC-18 had 50% fat content. It is estimated that 177 coconut trees will hold 354 cocoa trees and the dry bean yield ranged from the lowest of 410.6 kg to the highest of 1016 kg/ ha (Table 2a) which will provide income upto 1.35 lakhs.

**Table 2. Pod and bean characters of elite clones under coconut**

S. No.	Clones	No. of pods/ tree/year	Pod weight (g)	Bean no.	Single bean weight (g)	Shell (%)	Fat (%)
1	VTLC-1	62.3	350.6	40.8	1.00	12.0	45.6
2	VTLC-7	46.2	348.8	40.5	0.97	12.0	45.6
3	VTLC-8	47.3	386.0	41.7	1.07	12.0	45.6
4	VTLC-9	35.7	417.1	41.7	1.07	12.0	45.6
5	VTLC-17	35.3	320.5	41.7	1.07	12.0	45.6
6	VTLC-18	70.3	485.2	41.7	1.07	12.0	45.6
7	VTLC-22	61.2	410.6	41.7	1.07	12.0	45.6
8	VTLC-23	34.8	320.5	41.7	1.07	12.0	45.6
9	VTLC-1	42.0	320.5	41.7	1.07	12.0	45.6
	SEd	9.94	135.7	2.09	0.02	0.02	0.02
	CD	17.21	135.7	2.09	0.02	0.02	0.02

Table - 2a.

Dry bean yield and Income from Cocoa per hectare

Dry bean yield (kg/tree)	Dry bean yield/ha(kg)	Approximate income from cocoa (Rs.) @Rs. 135/1 kg dry bean
2.54	899.2 /	1,21,387
1.81	640.7	86,500
2.11	746.9	1,00,837
1.16	410.6	55,436
1.33	470.8	63,561
2.85	1008.9	1,36,202
2.87	1016.0	1,37,157
1.34	474.4	64,039
1.39	492.1	66,428

Yield of main crop coconut was also compared for seven years before and after planting of cocoa. There was a considerable change in the yield level of coconut as well. Before planting of cocoa the yield ranged from 51.4 to 56.2 nuts per palm per year whereas after cocoa cultivation it increased to 100 to 105.5 nuts per palm per year. This corroborated the results of earlier workers who have reported increase in coconut yield intercropped with cocoa both in single hedge and double hedge mixed cropping systems when compared with monocropped coconut (Nair *et al.*, 1975; Nair and Balakrishnan, 1977; Varghese *et al.*, 1978; Nair and Varghese, 1979).

... that the elite  
 ... CP-18 and VTLC P 1  
 ...  
 ... only 50 % are unproductive senile plantations.  
 One of the constraints of senile garden is presence  
 of old and unthrifty trees which need to be  
 replaced with fresh planting of high yielding  
 varieties. Wherever feasible senile plantations can  
 also be rejuvenated with decrowning as well as  
 ...  
 Directorate of Cashew Research, Puttur, Karnataka was

more, especially it affected adversely in the initial years of establishment and so removal of matured fronds in regular interval is advised. Systematic annual pruning is very much necessary to exploit the true potential of elite clones and to avoid incidence and spread of *Phytophthora* pod rot in this system. To reduce the maintenance cost and constant attention double hedge system of cocoa can be practiced preferably in widely spaced (9 m x 9 m) coconut gardens.

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