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Performance of cocoa clones as intercrop in coconut gardens under south Gujarat condition

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ABSTRACT

Field investigation on evaluation of cocoa clones for their performance as intercrop in coconut gardens was carried out for morphological and yield characters at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari, Gujarat during 2009-10 to 2016-17. Five clones *viz.,* VTLCC1, VTLCH-1, VTLCH-2, VTLCH-3 and VTLCH-4 were planted during 2009 under 46 years old WCT coconut garden with four replications in a Randomized Block Design. Data collected for plant height, stem girth, number of pods, pod weight, number of beans per pod, dry bean weight per tree per year and single dry bean weight revealed the significant variations among the five cocoa clones. The clone, VTLCC 1 recorded the highest plant height (4.20 m), stem girth (43.58 cm) and number of pods per tree per year (44.01), whereas VTLCH-4 registered the highest pod weight (134.40 g) and numbers of beans per pod (26.60) and single bean dry weight (1.20 g). Dry bean yield per tree per year was on par among the clones and ranged from 1.29 kg to1.59 kg per tree per year. With respect to overall coconut yield in the garden, the initial yield of coconut (WCT) was 60 nuts/palm/year and it increased upto 82 nuts/palm/year during the year 2016-17.

Keywords: Cocoa, coconut gardens, intercropping, yield

INTRODUCTION

Cocoa, as a commercial crop has gained importance in India from early 1970s and since then, Central Plantation Crops Research Institute (ICAR-CPCRI), Kasaragod has been actively involved in germplasm collection, introduction and evaluation. Coconut (Thomas *et al.,* 2010), arecanut (Sujatha *et al.,*2011), rubber (Blencowe. 1971) and oil palm (Amoah *et al.,*1995) are used as shade trees in Malaysia, India, Papua New Guinea and Brazil for cocoa cultivation. Coconut is highly amenable for different types of coconut based farming systems models with various crop combinations in intercropping, mixed cropping and multi-storeyed cropping *etc.,* (Dhanapal, 2010). As a monocrop, coconut does not fully utilize the natural resources like soil and sun light available in the garden. In coconut garden, with spacing of 7.5 m x 7.5 m, 75% of the planted area remains unutilized due to the specific distribution pattern of the root system of the crop. The active root zone of coconut is confined within 25% of the available area since the active region of the root system is concentrated within a radius of two meter around the base (Maheswarappa *et al.,* 2000). Therefore any crop, either seasonal or perennial which does not affect the growth of the palm, can be integrated in coconut garden for maximum returns from unit holding. Cocoa has been found biologically compatible and physiologically adaptive in coconut gardens (Jnanadevan, 2018). The increasing popularity of cocoa in India has necessitated the production of large number of high yielding hybrids and clonal materials with resistance to pest and diseases along with its suitability to different agro-climatic conditions. Evaluation of the germplasm/ released variety for yield and quality under humid tropics has helped in identification of elite materials which have acclimatized to Indian conditions. Hence, an effort was taken to screen cocoa clones for their performance as intercrop in coconut gardens under South Gujarat condition.

MATERIALS AND METHODS

Five cocoa clones *viz.,* VTLCC-1, VTLCH-1, VTLCH-2, VTLCH-3 and VTLCH-4 was received from Central Plantation Crops Research Institute, Regional Station, Vittal

and planted at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during 2009-10 at a distance of 3.75 m x 3.75m in a single hedge system under 7.5 m x 7.5 m spaced, 46 years old coconut garden (WCT) with four replications in a Randomized Block Design. Growth characters such as plant height, girth, height at first branching and canopy volume were measured from representative cocoa trees. The canopy area was calculated considering the canopy surface as cone shaped. The pod yield of individual trees in each clone during each harvest was recorded and given as average pod yield per tree per year for three years after yield stabilization. Pod characteristics such as individual pod weight and bean number per pod were measured from five pods of each tree. Beans were fermented, dried and single dry bean weight (SBW) and dry bean yield (DBY) per tree per year was recorded. The data collected in respect of various parameters of growth and yield attributes were analysed statistically as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

In cocoa, tree height and stem girth indicate good plant vigour, which possess a direct relationship with bearing, as cocoa is a cauliflorous plant. In the present study, clonal difference existed for plant height and stem girth (Table 1). Among the clones, VTLCC-1 registered maximum plant height and stem girth of 4.20 m and 43.58 cm, respectively which was on par with VTLCH-1, which recorded the plant height and stem girth of 3.87 m and 42.56 cm, respectively. In case of canopy spread at both directions *i.e.,* E-W and N-S, it was found to be non-significant among the clones. The differences in the plant height and tree girth of cocoa trees have been attributed to various factors such as environmental factors, soil moisture, availability of nutrients and genetic factor of the tree. Similar differences in the plant height and stem girth of clones and hybrids have been reported by Elain Apshara *et al*. (2009), Thondaiman *et al.* (2013) and Sumitha *et al.* (2018).

Table 1: Growth parameters of different clones as mixed crop in coconut garden

Clones	Plant height (m)	Stem Girth (cm)	Height at 1st branching (cm)	Canopy Spread (m)	
				E-W canopy	N-S canopy
VTLCC – 1	4.20	43.58	20.53	5.36	5.33
VTLCH – 1	3.87	42.56	31.65	5.35	4.94
VTLCH – 2	3.17	32.01	32.28	4.69	4.90
VTLCH – 3	3.55	34.23	31.55	4.97	4.92
VTLCH – 4	3.90	42.59	28.89	4.96	4.80
S. Em. +	0.15	0.86	0.77	0.28	0.27
CD (P=0.05)	0.45	2.64	2.37	NS	NS

Yield is the main selection criterion (Eskes and Lauaud, 2001) for any crop. In cocoa, yield is determined by yield contributing characters such as number of pods, dry bean yield per tree per year and pod value (Thondaiman *et al.,* 2013). The number of pods harvested per tree per year showed significant variation among the cocoa clones (Table 2) and VTLCC-1 registered the highest number of pods per tree per year (44.01) followed by VTLCH-4 (38.85) whereas, the clone VTLCH-1 recorded the lowest number of pods per tree per year (30.39). In respect to pod characters, the results showed that the pod weight and number of beans per pods were significantly different among the cocoa clones with higher pod weight and number of beans per pod being observed in VTLCH-4 (134.40 g and 26.60) followed by VTLCH-2 (126.70 g and 24.71). The number of beans decides the total weight of beans per pod. It is essential to select cocoa genotypes with more number of beans per pod so as to utilize the clones either in crop improvement for commercial plantations (Sumitha *et al.,* 2018). Pruning is an important practice to ensure proper ventilation within the crown and penetration of sunlight to stimulate cocoa flowering and fruit setting (USDA, 2007). These characters are influenced both by genetic as well as environmental factors which include soil moisture and nutrient status (Lachenaud and Oliver, 2005).

The economic part of cocoa crop is the beans and in the present study, single dry bean weight was observed from 1.10 g to 1.28 g. Among the clones, VLTCH- 2 recorded

Table 2: Pod and yield characteristics of different clones of cocoa as inter crop in coconut garden

Clones	No. of pods/tree/year	Weight of pod (g)	No. of beans/pod	Weight of single dry bean (g)	Dry bean yield/tree/year (kg)
VTLCC – 1	44.01	101.20	26.26	1.10	1.33
VTLCH – 1	30.39	110.10	22.90	1.12	1.28
VTLCH – 2	34.50	126.70	24.71	1.28	1.44
VTLCH – 3	31.61	122.50	19.38	1.16	1.32
VTLCH – 4	38.85	134.40	26.60	1.20	1.59
S. Em. +	1.28	1.78	0.68	0.04	0.14
CD (P=0.05)	3.93	5.49	2.10	0.12	NS

the highest single dry bean weight (1.28 g) and VTLCC-1 the lowest single dry bean weight (1.10 g). Enriquez and Soria (1968) observed that the dry bean weight of single bean varies from 0.5 g to 2.5 g. The dry beans per tree per year did not differ among the clones studied and it ranged from 1.28 kg to 1.59 kg per tree per year.

Growth and yield of coconut

In respect of coconut (WCT) growth and yield in the experimental garden, there was improvement in the growth as reflected in the increase in the number of leaves on the crown (Table 3). With regard to nut yield, the palms were giving 60 nuts /palm/year during 2008 to 10 and it was increased upto 82 nuts/palm/year in the year 2016-17. This could be attributed to better growth as indicated by increase in the number of functional leaves. The congenial of microclimate due to intercropping coupled with increased microbial activities and improvement in soil fertility might have favoured the growth and yield of coconut (Nair and Balakrishnan, 1977 and Nair and Rao, 1977). The improvement in nut yield of the main crop by intercropping has been reported earlier by Basavaraju *et al.* (2011) and Maheswarappa *et al.* (2013).

Table 3: Growth and yield of coconut in the experimental garden

Parameters	Pre-treatment observations (2008-09 to 2009-10)	Experimental period				
		2012-13	2013-14	2014-15	2015-16	2016-17
No. of functional leaves	30.0	33.2	34.7	35.9	36.5	37.4
Nut yield/palm/ year	60.0	68.3	70.9	74.5	78.1	82.0
Nut yield/ha/ year	10500	11952	12407	13037	13667	14350

CONCLUSION

From the present studies, based on growth and yield parameters assessed, it is evident that performance of all the clones of cocoa in terms of yield is on par in the initial years of establishment (six years after planting). Hence, continuous evaluation needs to be required to assess their yield potential and quality parameters when grown as intercrop in coconut gardens under south Gujarat conditions**.**

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