

# FIELD EVALUATION OF EXOTIC CACAO (*THEOBROMA CACAO* L.) ACCESSIONS

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## ABSTRACT

Exotic cacao clones obtained from Kew Botanical Garden, UK were evaluated for their field performance at CPCRI Regional Station, Vittal since 1991. The experiment blocks were laid out in RBD with two replications in a low-lying plot with sandy loam soil exposed to water stagnation for a period of six months every year. Growth measurements and the dry bean yield over four years (two each in their pre and post-yield stabilised age) have been included for various statistical analyses like ANOVA, Principal component, Correlation and Stability indices. Clones differed significantly in parameters like stem girth, weights of pruned biomass, number of cherelles and in dry bean yield. Na 242 clones showed the maximum bean yield with acceptable consistency indicated by CV (41.64%) while having had a moderate weight of pruned biomass of 3.770 kg. Most efficient lines have been those which produced more number of pods and dry beans from a small to moderate canopy. Number of cherelles (99.5%), stem girth and canopy volume (90.60%) contributed to the maximum variance observed through the first two principal components. Strong dependence of bean yield on cherule number, branch number and stem girth has been indicated.

## INTRODUCTION

Cocoa has been a suitable mixed crop in coconut and arecanut gardens (Bhat and Bavappa, 1972). Presently it is being cultivated in an about 14,618 ha with an annual production of 7837 metric tonnes of dry beans. The states of Kerala and Karnataka share the major area under this crop and its production. The present gap between the projected demand and the domestic supply indicates the vast potential of cocoa left untapped in India. This can be achieved either by increasing the area under cocoa cultivation -a difficult proposition under the areca cropping system-or by enhancing the productivity of the crop itself. This latter mentioned proposition sounds more healthy and practicable provided the basic requisite of genetic diversity with regard to different traits is at hands. One of the important constraints in the varietal improvement of cocoa is the restricted gene width / diversity seen in the available population in the country and more so at research stations. Hence an effort was made to enrich the germplasm with the inclusion of certain exotic and selected lines of cocoa from

Kew Botanical Garden, England and maintained at Lalbagh garden, Bangalore. Preliminary studies on such similar clones like that of ICS, IMC indicated wider variations among the accessions with regard to plant and pod characters have already been carried out (Nair, *et al.*, 1988). Further studies were laid out with fourteen clones collected over the years under a systematic randomised block design with the objectives of selecting the best clones with high potential yield.

## MATERIALS AND METHODS

An experiment with 14 clones was laid out at this CPCRI (RS), Vittal since 1991 in RBD with two replications. Growth measurements & the dry bean yield over four years (two each in pre and post-stabilized age) have been observed for and averaged for various statistical analyses like ANOVA, Principal component, Correlation and stability indices. Canopy volume has been derived by employing the following formula with the pre-assumption of the canopy being in the shape of cone and expressed in terms of cubic metre.  $Volume = \frac{\pi r^2 h}{3}$ , where  $r$  = radius of the canopy (m) and  $h$  = canopy height (m). Stem girth

has been measured at collar point on the trunk at about 10 cm above the ground by using vernier calliper and expressed in cm. Canopy height is derived by subtracting the height of the canopy at the jorquetting or first branching height from the total height of the plant and expressed in terms of metre. Observations on pruning was made four times in a year and the cumulative values have been utilized in the analysis and understanding the vigour of the plants.

**RESULTS AND DISCUSSION:**

Annual dry bean yield data revealed differential performance by the clones during their pre-stabilized and post stabilized period and even on pooled basis while all the four years data had been considered. Clones belonging to Na242 performed with maximum bean yield (0.538 kg/pl/annum) followed by those of ICS 95 (0.450 kg), SCA 12 (0.404 kg) and Na 33 (0.367 kg). Though there occurred a fluctuating phenomenon in the succeeding years of cropping among the clonal progenies of these clones, the pooled analysis indicated the above ranking order though they have been statistically on par with each other. The clones of SIAL 93 (0.152 kg/pl/ an) followed by those of Na 31 (0.183 kg) showed

the least potential bearing. Though overall performance by all the lines through out the blocks have been poor compared to their performance elsewhere due to the chronic stress caused by water stagnation during six months of every year. There has been a degree of variation in the expression of their relative potential performance by different cocoa lines. Four out of 14 lines have performed well compared to the others with regard to their dry bean yield. Na 242 clones have produced maximum yield (0.538 kg).

Among the growth parameters (Table 1) stem girth, canopy height and pruning weight showed statistical significant variations among the accessions while canopy volume and number of branches did not. Average stem girth indicated widest collars with clones of V-1 and lankiest collars with those of Na 33. The best proven clones of Na 242 had a moderate to medium stem girth.<sup>19</sup>

Moderate to high stem girth (wider stem girth at collar region) with this line might have reflected in the better bean yield projection. Positive and significant dependence of bean yield on stem girth as depicted substantiates this view and this has a strong backing up from the previous

**Table 1. Growth parameters**

Accession	Stem girth (av. of 3 yrs)	No. of branches (av. of 4 yrs.)	No. of cherelles (av. of 2 yrs)	Canopy height (av. of 4 yrs)	Canopy volume (av. of 4 yrs)	Prunings wt. (kg/pl)
1 ICS 95	8.19	3.43	9.36	1.28	1.57	3.470
2 ICS 1	9.96	3.53	33.53	1.69	4.04	4.430
3 IMC 67	10.90	4.17	8.73	1.68	3.57	6.445
4 Na 242	9.77	3.69	7.36	1.50	2.18	3.770
5 Na 33	6.46	3.25	2.92	1.04	0.89	2.870
6 Sca 12	9.93	3.61	20.95	1.40	2.24	3.000
7 ICS 6	9.96	3.58	9.03	1.07	1.71	4.700
8 SIAL 93	9.72	3.63	3.04	1.58	3.04	4.501
9 EET 272	9.32	3.72	6.53	1.20	5.26	6.000
10 IMC 10	10.68	3.80	11.31	1.41	2.83	4.450
11 Na 31	10.58	3.90	5.83	1.61	3.87	8.730
12 Sca 6	6.72	2.74	9.56	1.13	0.85	1.235
13 V-1	12.04	3.52	8.26	1.71	3.52	6.058
14 V-7	8.94	3.53	1.66	1.15	1.70	8.005
CV (%)	12.25	25.38	57.19	15.22	108.84	22.32
SEM ±	0.48	0.32	2.82	0.075	1.04	0.768
LSD(p=0.05)	1.374	NS	8.19	0.02	NS	2.162

**Table 2. Principal Components**

	Latent roots	% variation	Cumulative variance
PRIN 1	1413.70	77.251	77.25
PRIN 2	371.92	20.322	97.57
PRIN 3	28.01	1.531	99.10
PRIN 4	01.30	0.508	99.61
PRIN 5	4.97	0.271	99.88
PRIN 6	1.23	0.067	99.95
PRIN 7	0.64	0.0435	99.99
PRIN 8	0.28	0.0115	100.00

studies by Bhat *et al.* (1998). Total number of cherelles produced has exhibited the maximum say on the dry bean yield and this could be the main reason for the ultimate high production values with the better lines.

The canopy volume measurements ranged from a minimum of 0.85 cubic meter with clones of SCA 6 to a maximum of 5.26 cubic meter with those of EET 272. The Na 242 plants had an average measurement of 2.18 m<sup>3</sup>. Similarly the maximum canopy height was observed with V-1 clones while the minimum canopy height had been observed in Na 33. The best performing lines had a range from 1.0 m to 1.50 m (Na 242 clones).

Accessions differed statistically at significant level with respect to weight of prunings. The maximum prunings of 8.730 kg have been recorded with clones of Na 31 while the minimum of 1.235 kg noted with those of SCA 6.

Accessions did not differ statistically in the number of branches they had. However, they ranged from a minimum of 2.74 (SCA 6) to a maximum of 4.17 (IMC 67). When these parameters including potential bean yield (pby) were subjected to principal component analysis there occurred eight principal components with different values for latent roots and percent variations accounting on cumulative ground to 100.00 per cent variance among the data recorded on the said parameters (Table 2). The first two principal components had a major contribution towards the total variance observed (97.57 per cent).

The two principal components had a vector

**Table 3. Latent vector scoring of major principal components**

Cherelle No.	0.995	0.083
Stem girth	0.078	0.906
Height	0.023	0.061
Canopy volume	0.018	0.392
No. of branches	0.009	0.094
Bean yield	0.009	0.006
Canopy height	0.003	0.069

scoring of 0.995 in first component by the number of cherelles (Table 3). While the other had a major share of 0.906 by the stem girth and canopy volume. Correlation studies indicated interdependence of growth parameters and dependent variable (bean yield). Bean yield depended the most on number of cherelles followed by number of branches and stem girth.

Though canopy volume did not show any significant influence over the bean yield production the moderate canopy volume with better foliage spread in the canopy and a moderate vegetative flushing reflected in terms of prunings weight have helped these lines to coup up the chronic stress they have been exposed to. However, the Na 33 clones which were otherwise accepted as most tolerant clones to stresses failed in this experiment and have expressed the maximum value of CV (Table 4) double the limit normally accepted by previous workers (Bhat *et al.*, 1990).

The high yielding clones of Na 242 had a moderate pruning of 3.770 kg. These clones have exhibited the acceptable stability with a CV value of just above 40 percent with a maximum bean yield range. These clones were efficient producers of pods for they had a moderate canopy with better foliage spread. More number of branches in them provided space for cushion development and pod bearing. The interdependence between the bean yield and other yield and growth parameters like stem girth, number of cherelles and branches was confirmed. The stem girth at collar region and canopy volume have reaffirmed their strong influence over the total variance observed in the derived principal components.

**Table 4. Consistency measures**

Accession	Mean (a)	Standard deviation (b)	Coefficients of variation (C.V.) (%)	Range for the stable yield	
				(a-b)	(a+b)
1 ICS 95	0.540	0.256	56.89	0.194	0.706
2 ICS 1	0.280	0.088	31.32	0.193	0.309
3 IMC 67	0.294	0.130	44.22	0.164	0.424
4 Na 242	0.538	0.224	41.64	0.314	0.762
5 Na 33	0.367	0.312	85.01	0.055	0.679
6 Sca 12	0.404	0.173	42.82	0.231	0.577
7 ICS 6	0.302	0.104	34.44	0.198	0.406
8 SIAL 93	0.152	0.067	44.08	0.085	0.219
9 EET 272	0.293	0.170	58.02	0.123	0.463
10 IMC 10	0.324	0.177	54.63	0.147	0.501
11 Na 31	0.183	0.045	24.59	0.138	0.228
12 Sca 6	0.250	0.113	45.20	0.137	0.363
13 V-1	0.343	0.059	17.20	0.284	0.402
14 V-7	0.317	0.129	40.69	0.188	0.446

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