VARIABILITY IN POD AND BEAN CHARACTERS IN SOME CACAO HYBRIDS

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ABSTRACT

Variability for pod weight number of beans per pod, weight of wet beans with and without pulp, weight of peeled wet and dried beans, TSS of the pulp and fat content of the beans of ten cacao hybrids were studied. Field pod value for the ten hybrids was investigated.

Great variability for the characters exist between the hybrids and the date of harvest had significant effect on the characters studied.

INTRODUCTION

The importance of building up a wide germplasm collection of high inherent variability with representations from as many different sources as possible needs no emphasis. Such a collection provides exploitable variability from which new varieties can be developed. The dry seeds are the marketable product of a cacao tree and the pod-value studies provide fine details of commercially desirable yield characteristics of a cacao cultivar. Atanda and Jacob (1973) defined pod-value as the amount of dry peeled bean weight obtained per pod and therefore the product of mean number of beans per pod and mean dry peeled bean weight. It is related to other bean yield factors such as percentage of seed coat, wet to dry weight of bean (conversion rate), fat content and efficiency index (Jacob and Atanda, 1971).

Enriquez and Soria (1968) studied the variability in bean size, shell and pulp per cent and the number of beans per pod in cacao clones of different genetic origin and found significant differences for the characters studied. Wessel and Toxopeus (1967) reported that the bean weight was highest in September-

November (main season) and lowest in May (light season) under African conditions.

This study was initiated with a view to evaluate and study the extent of variability available for different pod and bean characters in the germplasm collection at this Institute and also the influence of data of harvest on these characters.

Materials and Methods

The experiment was carried out with the pods harvested from ten different accessions. These collections are from Malaysia/ Nigeria and 10-12 years old. They are interplanted with arecanut and irrigated. Five healthy open pollinated pods per accession were harvested and weighed. Pods were opened for the extraction of beans. The wet beans with the mucilage were weighed and the beans counted. A sample of twenty beans from each of the ten accessions was randomly selected and weighed. The mucilage was removed using saw dust and the weight of beans without mucilage was recorded. The wet and dry weights of peeled beans and the seed coats were also recorded.

For determining the total soluble sugars (TSS) of the pulp an extract was obtained by squeezing the beans along with pulp and the extract was filtered. The TSS of the filtrate was determined using an Abbe's refractometer.

All these determinations were repeated during May to July (1981) for six harvests at an interval of about 15 days. May represents the fag end of the dry summer season and June and July, heavy monsoon period.

Efficiency index which is the fresh weight (g) of pod required to produce one gram of oven dried peeled beans was calculated. All the data were statistically analysed.

Results and Discussions

Table I gives the results of the studies on the pod-value factors for different accessions. Wide significant variations existed in all the pod-value factors between the accessions. Pod-value was

highest (40.03 g) in the Amel × Na33 progenies and lowest (14.98 g) in C 79 progenies. In other words the former accession had larger number of beans per pod and greater bean weight which would have come from the Amelonado parent. Atanda and Jacob (1973) reported the superiority of Amelonado over the Amazon in all the pod-value factors investigated. The number of beans which is the most variable component of the pod-value (Toxopeus and Jacob, 1970) has a genetic potential equal to the number of ovules per ovary (Jacob, 1969). But this genetic potential can hardly be attained in the field because of inadequate, inefficient or inconsistent natural pollination (Toxopeus and Jacob, 1970).

The efficiency index varied greatly between the hybrids (11.79 g to 17.13 g) (Table 1). The highest efficiency index was found in $P_3 \times P_1$ progenies and the lowest in $P_6 \times P_4$ progenies. Higher the efficiency index greater the pod materials required to produce 1 g of dried peeled beans which in turn needs more fertilizer application (Atanda and Jacob, 1973).

The influence of date of harvest on different pod value factors is given in the Table II. May to June can be said to be the main harvesting season in South Kanara District, where cacao is planted as a mixed crop with arecanut and is usually irrigated. Pod value was significantly reduced from the fourth harvest (30th June) onwards. This was due to the reduction in the dry weight of the peeled beans and not because of the reduction in the number of beans per pod which is a genetically determined character. However been size has bean reported to be controlled by Mendelian genes (Glendinning, 1963). But it may be affected by the seasons too. Toxopeus and Wessel (1970) reported that the pods which developed in a period of considerable water stress had much lower pod-value than pods which developed during periods of adequate water supply. Significant reduction in the pod-value factors (dried peeled bean weight) for the later half of the harvesting season studied may be because of their development under a condition of inadequate availability of water during peak of summer.

Tables III and IV give the percentage of pulp and the pulp TSS for different accessions and the influence of date of harvest on these characters respectively. Significant variation was noted

Table 1. Studies on pod-value factors of different accessions

S. No.	Accession	Mean fresh wt. per pod (g)	Number of beans per pod	Mean dry wt. per peeled bean	(%) seed coat	Wet to dry wt. of peeled beans conversion rate (%)	Pod-value (g)	Efficiency index
1.	P6× P4 ..	265.83	35.22	0.58	11.21	67.56	21.88	11.79
2.	P12× P2 ..	393.33	41.74	0.71	16.05	73.80	29.86	13.79
3.	C 79 ..	285.50	29.75	0.50	21.63	77.28	14.98	15.67
4.	T 67/7 ..	298.50	38.87	0.58	16.35	83.47	23.73	13.72
5.	P3× P1 ..	235.33	35.81	0.48	16.72	71.49	17.32	17.13
6.	NC-27 (?)	219.50	27.99	0.62	17.25	73.77	20.38	14.79
7.	Amel× Na 32 ..	295.62	38.30	0.69	14.48	68.95	21.68	19.81
8.	Pa 7× Na 32 ..	391.83	38.28	0.82	18.53	71.54	16.47	13.73
9.	Amel× Na 33 ..	405.33	41.66	0.96	17.59	71.84	40.03	14.43
10.	Red Axil (?) ..	270.55	42.50	0.72	13.97	66.26	30.11	11.94
	CD at P= 0.05 ..	82.345	5.983	0.16	3.134	5.664	8.269	3.022
	Variance due to accessions	5.51**	5.52**	7.32**	3.78**	2.63*	7.03**	3.72**

* Significant at P=0.05 ** Significant at P= 0.01 (?) Doubtful genotype.

Table 2. Influence of date of harvest on different pod-value factors

Date of harvest	Mean fresh wt. per pod (g)	No. of beans per pod	Mean dry wt. per peeled bean	% of seed coat	Wet to dry wt. of peeled beans conversion ratio (%)	Pod-value (g)	Efficiency index
19.5.1981	379.1	38.39	0.89	15.38	65.21	31.59	12.47
30.5.1981	324.1	37.72	0.81	16.23	64.29	30.22	11.26
15.6.1981	347.1	38.42	0.75	16.78	79.76	27.22	12.91
30.6.1981	271.1	36.89	0.49	15.44	74.57	17.41	14.13
15.7.1981	258.2	36.02	0.49	14.94	75.77	17.02	13.68
30.7.1981	294.1	34.66	0.57	16.66	76.56	19.36	15.35
CD at P=0.05	63.784	..	0.119	..	4.371	6.405	2.341
Variance due to date of harvest	4.27**	..	16.78**	..	12.37**	9.23**	2.97*

* Significant at P=0.05 ** Significant at P=0.01

Table 3. Pulp % and pulp TSS for ten different cacao accessions

S.No.	Accessions		(%) pulp	(%) pulp TSS
1.	P6× P4	..	38.54	16.36
2.	P12× P2	..	45.31	15.47
3.	C 79	..	48.49	16.91
4.	T 65/7	..	41.97	15.12
5.	P3× P1	..	47.87	13.68
6.	NC-27 (?)	..	42.46	16.54
7.	Amel× Na 32	..	43.54	16.54
8.	Pa 7× Na 32	..	44.56	17.41
9.	Amel× Na 33	..	47.87	18.33
10.	Red Axil (?)	..	34.53	17.08
	CD at P= 0.05	..	5.652	1.941
	Variance due to accessions	..	4.960*	11.740**

(?) Doubtful genotype

Table 4. Influence of date of harvest on pulp% and pulp TSS (%)

Date of harvest		(%) pulp	(%) pulp TSS
19.5.1981	..	29.54	19.28
30.5.1981	..	39.12	18.94
15.6.1981	..	45.04	15.14
30.6.1981	..	50.32	15.33
15.7.1981	..	45.73	14.72
30.7.1981	..	50.38	13.94
CD at P= 0.05	..	4.378	1.503
Variance due to date of harvest		26.02**	52.39**

between accessions for the per cent of pulp (34.53 to 48.49) and the pulp TSS (13.68 to 18.33%). Date of harvest had significant effect on both these characters. Gradual increase in the pulp per cent and a decrease in the pulp TSS would have occurred because of the higher moisture content in the pulp subsequent to the onset of monsoon. The TSS and moisture in the pulp will have an important role during processing of beans as fermentation is very much dependent on these two factors. Larger quantities of pulp per bean means higher contents of nutrients (sugar and

acids) for potential fermentation and this might result in more acid beans. Similarly larger content of water is also an undesirable character as this will reduce the degree of aeration of ferment (Carr *et al.* 1979).

Plants having significantly higher number of beans and higher bean weight are useful in breeding programmes. The differences in the per cent of pulp and TSS content between the accessions and between the dates of harvest is worth studying for its influence on the bean acidity after fermentation.

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