GROWTH AND YIELD PERFORMANCE OF SELECTED COCOA CLONAL AT SERIAN, SARAWAK

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Malaysian Cocoa J. 14: 92-95 (2022)

ABSTRACT - *Malaysian Cocoa Board (MCB) has established several Local Verification Trial throughout Malaysia under the development project entitled Bahan Tanaman Koko Unggul, in the 11th Malaysian Plan. The main objective of this study is to evaluate and compare the performance of new selected cocoa clonals at Serian, Sarawak. Research data such as the potential yield, pod and bean analysis, and vascular streak dieback disease assessment were collected from 2015 until 2019. Several selected cocoa clonals show promising potential compare to the commercial cocoa clones.*

***Key words*:** Cocoa clonals, potential yield, commercial cocoa clones

INTRODUCTION

The origin of cocoa (*Theobroma cocoa L.*) can be traced back to the South American Amazon basin as the native understory topical tree (Bartley, 2005). The cocoa tree belongs to the Malvaceae family and genus *Theobroma*, which contains 22 species (Bayer *et al.*, 1999). This tree produces seeds or cocoa beans which is the main raw material for the multi-billion chocolate industry. The cocoa beans on the other hand have become the major agricultural income for millions of farmers in Africa, Asia, Central and South America. Currently, Cote d'Ivoire, Ghana, Cameroon, Nigeria, Indonesia, Ecuador, Brazil and Peru are the main cocoa producing countries. Traditionally, all cocoa trees were divided into three main groups including Criollo, Forastero and Trinitario based on their morpho-geographical traits of trees and pods.

Currently, most of the commercial cocoa clones recommended to local farmers are clones such as PBC 123, KKM 22, MCBC 1, MCBC 8, MCBC 10 and BR 25. Malaysian Cocoa Board (MCB) cocoa breeding program has developed many cocoa trial plots with the objectives to improve the present cocoa planting materials in terms of yield production, tolerance to main diseases (black pod and vascular streak dieback) and pest, and good bean quality. New cocoa clonals have been selected from the established cocoa clonal trial to be evaluated at different locality as local verification trial (LVT) throughout Malaysia under the development project entitled *Bahan Tanaman Koko Unggul*, in the 11th Malaysian Plan. One of the selected locality is Serian, Sarawak where the new selected cocoa clonals were planted to assess their suitability, growth and yield performance.

MATERIALS AND METHODS

The present study was conducted from January 2015 until December 2019 at Tebakang, Serian, Sarawak which used to be among the main cocoa growing area in Sarawak. Twenty cocoa clonals selected from MCB cocoa breeding program were used in the study (Table 1) also include local commercial cocoa clones such as PBC 123, KKM 22 and MCBC 8. Grafted plants of these cocoa clonal have been planted according to randomized complete block design with three replications. Each replicate consisted of twenty trees planted in double rows with 3 m of spacing between both trees and plots. All standard field maintenance were applied uniformly to each tree as follows: 4 x 270-300 g/tree per year 12N-12P-17K-TE fertilizer; canopy pruning for height; regular pruning for disease control, black pod control using metalaxyl fungicides during wet seasons, and weed control by a combination of herbicides and bush cutter. Girths of the main trunk was measured twice per year (April and October) from 2015 until 2019 as one of the primary data from which growth analysis quantities were derived. Girth measurement were measured at the same position marked with paint mark.

Phenotypic data was recorded on a single tree basis and the number of mature pods were taken monthly over a 3-year period. The total number of pods harvested per year were evaluated as one of the main yield components. The dry cocoa beans were prepared according to normal procedure; fermentation of the raw beans for 4-5 days and sun-drying 5-7 days. The characteristics measures included average bean weight, pod weight, husk content, and number of beans per pod for each hybrid. Pod value was expressed as the number of pods required to produce 1 kg of dried beans. Pod

Value = 1000/ (bean number x mean bean weight). Potential yield ($Kg \cdot ha^{-1} \cdot year^{-1}$) for each hybrid was estimated from pod production divided by pod value multiplied by 1,000 trees/ ha and a correction factor 0.83.

The extent of disease symptom severity or damage is quantified by using a disease severity or damage scale. The scale used is from 0-6 [0 – healthy; 1 – infected leaf, few or many; 2 – infected leaf, some or most of which showing chlorosis in progress; 3 – most of infected leaves showing chlorosis and necrotic, still remain attached; 4 – infected leaves began to abscise; 5 – most infected leaves have abcised, apparent cessation of first flush growth; 6 – near complete defoliation, dieback on progressive damage from chlorosis to defoliation to dieback. This method of measurement incorporates both the incidence and the extent of damage caused by the disease.

RESULTS AND DISCUSSIONS

The tree girth diameter and tree height represent the indication of plant vigour. We observed that the stem girth increased correspondingly with plant height. Among the selected cocoa clonals, A07 registered highest girth diameter of 32.50 cm which was on par with local commercial cocoa clones, PBC 123 which recorded girth diameter 32.18 cm. The number of branches per tree ranged from two to five. The differences in the tree girth maybe due to multi various such as genetic factor of the tree and hilly surface condition in that area. Since cocoa is a cauliflorous plant, rapid tree growth can promote early yield production but requires a lot of tree maintenance such as pruning.

The main selection criterion in MCB cocoa breeding program is yield and it also true as for other main crops (Eskes and Lauaud, 2001). Yield is determined by yield contributing characters such as number of pods per tree, dry bean yield per tree and pod value (Thondaiman *et al*., 2013). The number of pods harvested per tree showed significant variability among the selected cocoa clonals (Table 1). Among them, A07 recorded the highest number of pods per tree (43.62), followed by A05 (38.93) while, the clonal A020 recorded the lowest number of pods per tree (10.71).

Figures 1- 5: Mature cocoa pod of cocoa clonals (From left: Clone code A01, A02, A05, A018 & A014).

As regards to average dry bean weight (ADBW), the results showed that the ADBW was significantly different among the cocoa clonals, highest weight was observed in A016 (1.64g) followed by A014 (1.44g). Dried cocoa beans which weight more than 1.00g per bean are favoured by the cocoa farmers as they can obtain higher price from the purchaser according to Standard Malaysian Cocoa (SMC) 1 released by MS 230:2007. The weight of cocoa beans from the same cocoa clonal but planted at different location may be slightly different influenced by the ecological and environmental factors. The potential yield (Kg/Ha/Year) of cocoa clonal A014 was the highest (1,290 Kg), followed by A05 (1,220 Kg) while others showed below potential yield of the commercial cocoa clones.

The assessment of vascular streak dieback (VSD) was carried out for the selected cocoa clonals since this disease have been found in most cocoa growing areas around Malaysia and also Southeast Asia. This disease was caused by the basidiomycete, *Oncobasidium theobromae* and the initial symptom was the chlorosis of single leaf, usually on the second or third flush behind the shoot apex (Guest and Keane, 2007). The result of VSD assessment showed that the tolerance level of new selected cocoa clonals (DSI Score: 1.00-1.30) in Table 1 were comparable to the existing commercial cocoa clones in this study.

Table 1. Performance of selected cocoa clones for morphological and reproductive traits.

CODE NAME	GIRTH (cm)	No of Pods Per Tree	BNP	BCR (%)	ADBW (g)	PV	VSD Score (DSI)	DBY (Kg/Tree/Year)	Potential Yield (Kg/Ha/Year)
A01	26.33	11.89	44.00	34	0.735	34.89	1.00	0.34	340
A02	30.06	13.96	28.00	27.24	1.023	40.06	1.30	0.35	350
A03	29.19	30.93	34.63	20.78	0.569	55.24	1.00	0.56	560
A04	31.18	24.62	30.38	35.36	0.84	41.49	1.00	0.59	590
A05	31.53	38.93	34.65	34.1	1.016	31.96	1.00	1.22	1,220
A06	27.5	24.61	26.33	37.21	0.926	44.06	1.30	0.56	560
A07	**32.5**	**43.62**	21.78	26.89	0.847	58.57	1.00	0.74	740
A08	27.77	15.00	40.83	35.88	0.71	35.32	1.00	0.42	420
A09	26.77	26.78	34.73	33.58	0.912	32.53	1.70	0.82	820
A011	31.63	17.21	32.00	25.6	1.116	31.99	1.00	0.54	540
A012	30.4	30.00	26.82	29.71	1.182	32.39	1.30	0.93	930
A013	28.72	31.52	39.90	28.8	0.51	51.24	1.00	0.62	620
A014	29.09	26.27	37.00	34.55	1.442	20.38	1.30	1.29	1290
A016	28.84	11.03	41.25	30.16	**1.642**	15.71	1.30	0.7	700
A018	24.11	11.62	25.99	25.99	1.068	33.46	1.70	0.35	350
A020	22.66	10.71	29.67	26.09	0.821	55.36	1.30	0.19	190
PBC 123	32.18	24.67	30.00	33.93	1.11	27.33	1.00	0.9	900
KKM 22	24.57	12.36	38.00	33.59	0.71	37.06	1.00	0.33	330
MCBC 8	26.89	17.00	**47.00**	31.52	1.048	20.75	1.00	0.82	820
MEAN	28.52	22.25	33.84	30.79	0.96	36.83	1.17	0.65	645.79
SD	2.82	9.89	6.83	4.44	0.28	12.05	0.23	0.30	

CONCLUSIONS

Based on the growth and yield parameters assessed among the selected cocoa clonals, A05 and A014 were identified as potential new cocoa clones to be introduced to the cocoa farmers as commercial cultivation. However, the performance and yield sustainability may produce slight variation due to different environment and ecological factors.

ACKNOWLEDGMENTS

This research was co-funded by the Ministry of Finance, 11th Malaysia Plan, Projek Bahan Tanaman Koko Unggul and Malaysia Cocoa Board. The authors acknowledge the Director General of Malaysian Cocoa Board for the permission to publish this paper. Appreciation is extended to the Deputy Director-General (Research & Development) and Director of Cocoa Upstream Technology Division for their guidance.

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