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Performance of quality parameters in seedling progenies of identified cocoa plus trees under Tamil Nadu condition

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Abstract
Main aim of this study to evaluate the performance of quality parameters in seedling progenies of identified cocoa plus trees under Tamil Nadu condition. Ten plus trees were evaluated for two cropping period from July 2014 to June 2015. Out of ten plus trees studied for quality characters, the fat content was the highest (56.1 per cent) in VPS 13. While the highest (87.04 mg equivalent for pyrocatechol per gram) total phenol content in cocoa beans was recorded in VPS 15. Similarly, the mean performance of plus trees showed that the highest (25.41 per cent) total carbohydrate content was recorded by VPS 15 over one year. The quality characters such as fat content, total phenol content and carbohydrate content were influences by the genetic potential of the plus trees. These plus trees, further useful for breeding program to enhance the quality traits.

Keywords: plus trees, quality and Tamil Nadu

Introduction
Cocoa (*Theobroma cacao* L.) is important beverage crop after tea and coffee. The family is Malvaceae (Alverson *et al*., 1999) [1]. The word *Theobroma* finds its origin in the Greek language, meaning 'Food of the Gods'. Bean is an economic part of cocoa. The active constituent present in the bean is theobromine, a compound similar to caffeine, a component of different cocoa ingredients and chocolate preparations (Francene, 2003) [4].
The industrial aspects cocoa bean is useful for chocolate preparation, biscuit preparation, cocoa mass, cocoa butter preparation and pharmaceutical industry. The active ingredients contain antioxidant properties. It is also considered as a functional food because of rich source of polyphenols and antioxidant properties. It is rich source of fat (37%) and protein (7%).
The work is mainly focused on to evaluate the performance of quality parameters in seedling progenies of identified cocoa plus trees under Tamil Nadu condition.

Materials and Methods
The study was conducted at Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The plus trees of cocoa available in the farmer's field at Anaimalai region of Coimbatore were observed for their yield and quality during two different seasons (July to December, 2014 and January to June, 2015) for a period of one year. 10 trees were identified to be promising plus trees and then evaluated based on quality parameters.

Table 1: Locations of plus trees under study

S. No.	Place of collection	Plus trees / Elite trees	Age (Years)
1.	Sethumadai Jayaraj Plantation (SMJ)	SMJ 3, SMJ 4, and SMJ 15	14
2.	Sethumadai Engineer Plantation(SME)	SME 9, SME 24, and SME 26	14
3.	Vettaikaranpudhur Sabapathy Plantation (VPS)	VPS 12, VPS13 and VPS15	13
4.	Kulathupudhur Selvaraj Plantation (KUL)	KUL 2	13
Total		10	-

After fermented and dried beans were used for analyze the fat, phenol and carbohydrate content. Fat was estimated by petroleum ether extraction method using Soxhlet apparatus and expressed in per cent. Folin-Ciocalteau reagent method was used for estimating the total phenols and the values are expressed as mg equivalent for pyrocatechol per grams (Bray and Thorpe, 1954) [2]. Total carbohydrates was estimated following the anthrone method as

described by Sadasivam and Manickam (2008) [6] and expressed in per cent.

Quality characters

Fat content (per cent) (Table 2)

Season I (July 2014 to December 2014)

The fat content recorded during season I showed differences among the ten plus trees. The plus trees, VPS 13 recorded the highest (56.3 per cent) value of fat content followed by SMJ 4 (52.6) while the lowest (50.1 per cent) value was recorded in VPS 15. The ten plus trees showed the mean value of 51.9 per cent for the fat content with CV value of 3.3 per cent.

Season II (January 2015 to June 2015)

The ten plus trees of cocoa studied for fat content during season II showed noticeable differences and the highest (55.8 per cent) value was recorded in VPS 13 followed by SMJ3 and SMJ 15 while the lowest (49.1 per cent) value was observed in VPS 15. The mean fat content observed in plus trees during the season II (51.4 per cent). During the study, the maximum fat content was present in VPS 13, whereas the minimum fat content was recorded in VPS 15 in both seasons.

Table 2: The mean performance of plus trees of cocoa for fat content (Per cent) in different seasons

S. No	Plus trees	Fat content (per cent)		
		2014-15		
		Season I	Season II	Mean
1.	SMJ 3	52.5	52.6	52.6
2.	SMJ 4	52.6	50.8	51.7
3.	SMJ 15	51.0	52.6	51.8
4.	SME 9	51.3	49.6	50.5
5.	SME 24	50.7	51.3	51.0
6.	SME 26	51.2	50.7	51.0
7.	VPS 12	52.0	51.6	51.8
8.	VPS13	56.3	55.8	56.1
9.	VPS15	50.1	49.1	49.6
10.	KUL 2	51.4	49.8	50.6
	Mean	51.9	51.4	51.7
	Maximum	56.3	55.8	56.05
	Minimum	50.1	49.1	49.6
	SD	1.7	2	1.8
	CV (%)	3.3	3.9	3.5

Total phenol content (Table 3)

Season I (July 2014 to December 2014)

The total phenols content during season I showed a range from 66.90 to 86.76 mg / g with a mean value of 78.44 mg / g. The highest value was registered in VPS 15 followed by VPS 12 (85.32 mg / g) and lowest value was registered in SMJ 15 with CV value of 9.41 per cent.

Season II (January 2015 to June 2015)

The ten plus trees of cocoa studied for total phenol content during season II showed marked differences and the highest (87.32 mg / g) value was recorded in VPS 15 followed by VPS 12 (84.92 mg / g) while the lowest (66.98 mg / g) value was observed in VPS 13. The mean total phenols content observed in plus trees during the season II was 78.50 mg / g with CV value of 9.04 per cent. VPS 15 recorded maximum phenol content with mean value of 87.04 mg / g during the two seasons.

Table 3: The mean performance of plus trees of cocoa for total phenols (mg equivalent for pyrocatechol per gram) in different seasons

S. No	Plus trees	Total Phenols (mg equivalent for pyrocatechol per gram)		
		2014-15		
		Season I	Season II	Mean
1.	SMJ 3	71.54	72.62	72.08
2.	SMJ 4	74.40	74.86	74.63
3.	SMJ 15	66.90	69.46	68.18
4.	SME 9	82.48	83.92	83.2
5.	SME 24	82.13	81.62	81.88
6.	SME 26	85.02	84.22	84.62
7.	VPS 12	85.32	84.92	85.12
8.	VPS13	68.66	66.98	67.82
9.	VPS15	86.76	87.32	87.04
10.	KUL 2	81.16	79.02	80.09
	Mean	78.44	78.50	78.47
	Maximum	86.76	87.32	87.04
	Minimum	66.90	66.98	67.82
	Standard deviation	7.38	7.10	7.20
	CV (%)	9.41	9.04	9.18

Total carbohydrate content (Table 4)

Season I (July 2014 to December 2014)

The carbohydrate content recorded during season I showed differences among the ten plus trees of cocoa. The plus tree, SMJ 15 recorded the highest (26.59 per cent) carbohydrate content followed by the plus tree SMJ 3 (25.49 per cent) while the lowest (19.67 per cent) value was recorded in SMJ 4. The mean value for the carbohydrate content of ten plus trees was 22.60 per cent with a coefficient of variation value of 10.84 per cent.

Season II (January 2015 to June 2015)

The ten plus trees studied for carbohydrate content during season II showed differences and the maximum (25.68 per cent) value was recorded in VPS 15 followed by SME 26 (24.58) while the lowest (19.12 per cent) value was observed in SME 24. The mean carbohydrate content observed in plus trees during the season II was (22.47 per cent) with CV value of 8.68 per cent.

Table 4: The mean performance of plus trees of cocoa for total carbohydrate content (per cent) in different seasons

S. No	Plus trees	Total carbohydrates content (per cent)		
		2014-15		
		Season I	Season II	Mean
1.	SMJ 3	25.49	22.04	23.765
2.	SMJ 4	19.67	20.58	20.125
3.	SMJ 15	26.59	21.85	24.22
4.	SME 9	19.85	21.12	20.485
5.	SME 24	20.40	19.12	19.76
6.	SME 26	21.49	24.58	23.035
7.	VPS 12	23.31	23.86	23.585
8.	VPS13	22.04	22.95	22.495
9.	VPS15	25.13	25.68	25.405
10.	KUL 2	22.04	22.95	22.495
	Mean	22.60	22.47	22.54
	Maximum	26.59	25.68	25.41
	Minimum	19.67	19.12	19.76
	Standard deviation	2.45	1.95	1.88
	CV (%)	10.84	8.68	8.34

Cocoa butter is the major commercial product extracted from beans of cocoa. Fat content of cocoa beans is considered to be an important criterion in commercial point of view. In cocoa, the quality of beans is determined by two main parameters *viz*., fat and polyphenols. Phenolic compounds present in the cocoa beans contribute to the quality of raw cocoa, which serves as the basis of all chocolate products (Karthik kumar, 2014) [5]. The polyphenol content showed considerable variation among the plus trees identified. In present study poly phenol content ranged from 67.82 to 87.04 mg equivalent for pyrocatechol per gram. The total carbohydrate content in cocoa beans varied among the plus trees evaluated. In present study, it ranged from 19.76 to 25.41 per cent and the highest total carbohydrates content was recorded by VPS 15. The maximum value of total carbohydrate content exhibited by the plus trees may be due to their efficiency in partitioning of assimilates and thus could be selected for further crop improvement programme (Karthikkumar, 2014) [5]. Similar result of variability in carbohydrate content was reported by Fapohunda and Afolayan (2012) [3] in cocoa.

Conclusion

Among the ten plus trees, the quality parameters showed wider variation. The quality characters such as fat content, total phenol content and carbohydrate content were influences by the genetic potential of the plus trees. The plus trees, VPS 13 recorded the highest (56.3 per cent) value of fat content followed by SMJ 4 (52.6). Fat content is important criteria for improve the quality of cocoa bean. These plus trees, further useful for breeding program to enhance the quality traits.

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