Agrotech Journal ATJ
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Yield Potential Analysis of Cacao Clones in Various Location in East Kolaka Regency, Southeast Sulawesi

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ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 2, No. 1, June 2017
URL : http://dx.doi.org/10.31327/atj.v2i1.942

Abstract

The Southeast Sulawesi government has designated Kolaka Timur as one of the cocoa production centers in Southeast Sulawesi. One of the successes of the superior seed assembly business depends on the availability of complete and accurate information about the potential of cocoa to be chosen as elders for subsequent development, so that yield analysis and early selection in the analysis of genetic diversity of smallholder cocoa have been developed in that location. This research was carried out using the Split-Plot Design (RPT). Sampling was carried out in 3 main locations (L) with an area of ± 2 ha, in each of the main locations divided into three plots (P) namely plots one Sulawesi 2 clones, plots two local clones and plots 3 MCC02 clones. A sampling of cacao leaves and fruit was taken as many as 30 samples with three replications per location. The results showed that cocoa which has the potential for good yields to be developed in the East Kolaka Regency based on the analysis of the component production of dry seed weight was the MCC02 cocoa clone with an average of 35.33 grams of fruit (L2P3) respectively. The different locations show different levels of Cacao yield and adaptation

Keywords: Cacao, Clones, yield potential, local genotype

A. Introduction

Indonesia is the world's third largest exporter of cocoa beans with 550,000 dry seed production (ICCO, 2011). Sulawesi is known as the center cocoa producing area in Indonesia with a land area of 538,760 ha or 68% of the national cocoa land area. Poli – Polia sub-district is the center of cocoa bean production in East Kolaka with an increase in the land area of 6.31% per year with an average planting area of 7,176 ha per year and become the largest area of cocoa plantations in Southeast Sulawesi. However, in 2012, there was a decline in production to 48,823 tons in 1 year (Dinas Perkebunan Kabupaten Kolaka, 2013). The productivity of cocoa land is still low, each around 753 kg/ha/ year (Dinas Pertanian, Kehutanan, dan Perkebunan Kabupaten Kolaka Timur, 2014). Cocoa productivity in East Kolaka decreased compared to previous years, the decrease in production was due to the age of cocoa plants ao 18 years, high intensity of pest attacks, not yet utilizing superior seeds (Dinas Perkebunan Kabupaten Kolaka, 2013)

Completion of the problem of decreasing cocoa production needs to be done in an integrated manner between various components of cultivation. Plant material is a component that underlies the success of the plant cultivation process, but until now the adoption of cocoa superior plant material is still relatively low. Cocoa plantations in Southeast Sulawesi are smallholder plantations that have evolved from generation to generation, so farmers in the field tend to use available plant material on land that is not identified by their breeders. The choice of plant material is an essential initial action in cocoa cultivation (Susilo, A.W., 2007). Recommended plant material must be of high yielding broodstock, high-quality seeds, and resistant to pests and diseases. One of the successes of the superior seed assembly business depends on the availability of complete and accurate information about the genetic diversity of cocoa that will be chosen as an elder (Rubiyo, 2009). Analysis of cocoa genetic diversity on smallholder plantations in East Kolaka still needs to be done, considering that the government of Southeast Sulawesi has designated Kolaka Timur as one of the cocoa production centers in Southeast Sulawesi. Superior plant material that has high yield and production is a criterion that demands cocoa cultivation activities, so in this study, an analysis of production and the initial selection was carried out in the analysis of the genetic diversity of smallholder cocoa plantations.

B. Methodology

The samples taken in this study were cocoa plants that had long been developed by the community in East Kolaka Regency. This research was carried out using the Split-Plot Design. Sampling was carried out in 3 main locations (L) with an area of ± 2 ha, in each of the main locations divided into three plots (P) namely plots one Sulawesi 2 clones, plots two local clones and plots 3 MCC02 clones. A sampling of cocoa leaves and fruit was taken as many as 30 samples with three replications per the main location so that the total sample observations amounted to 270 samples.

Production analysis was carried out by observing production components which consisted of a number of fruits per plant, the weight of fruit (g), number of seedlings, the weight of fresh seeds (g) and weight of dry seeds (g). Observation of the weight of dry seeds is done by removing seeds from the fruit, then remove the fruit until clean. Cacao beans that have been cleaned, then dried are dried in the sun. Data were analyzed using F-test and continued with the LSD test..

C. Result and Discussion

High yielding superior crop material is a criterion that demands cocoa cultivation. Selection of superior cocoa plant material in this study was carried out by observing the components of production, namely the number of fruit, fruit weight, number of seeds, the weight of fresh seeds and weight of dry seeds in the three observation locations. Observation of production components shows results that vary in each location. The first location was superior to the number of seeds with an average number of seeds as much as 48.33 in the cocoa clone MCC02 (LIP3). The second location was superior to fruit weight, fresh seed weight, and dry seed weight respectively with an average of 503.08 grams (L2P2) on local clones, 140.29 grams (L2P2) on local clones and 35.33 grams (L2P3)) on MCC02 clones. The third location is superior to the number of crop fruits with an average of 39.30 (L3P1) in Sulawesi clones 2.

Observations on the character of the average number of fruits per plant, fruit weight, number of seeds of fresh and dry seed weight showed that there were significant effects due to differences in clones and cocoa planting locations. At location one (L1) the best clones for fruit number per plant were P2 (34.42 pieces), the best clones at location 2 (L2) were P3 (17.48 pieces) and the best clones at location three (L3) were P1 (39.30 pieces). The best locations for P1 clones are L3, P2 and P3 clones at location L1 (Table 1).

Table 1. Number of fruit crops

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$30,50^{b}_{y}$	$34,42^{a}_{x}$	$28,50^{a}_{y}$	4, 61
L2	$15,58^{c}_{x}$	$14,75^{c}_{x}$	$17,48^{c}_{x}$	
L3	$39,30^{a}_{x}$	$30,07^{b}_{y}$	$22,01^{b}_{z}$	
NP BNT$_{0.05}$	3,62			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level $\alpha = 0.05$

Table 2 shows that at location one (L1), the best clone is P3 (418.26 g). The best clone at location 2 (L2) is P2 (503.08 g), and the best clone in location three (L3) is P1 (470.68 g). The best location for P1 clones is L3, P2 and P3 clones at L2 location.

Table 2. Fruit Weight (g)

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$339,27^{b}_{x}$	$333,17^{c}_{x}$	$418,26^{a}_{x}$	92,55
L2	$451,98^{a}_{x}$	$503,08^{a}_{x}$	$468,50^{a}_{x}$	
L3	$470,68^{a}_{x}$	$406,15^{b}_{x}$	$442,33^{a}_{x}$	
LSD Test$_{0.05}$	72,64			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level $\alpha = 0.05$

The best locations for the average number of seeds were P1 clones (31.78), and P2 (39, 54) were location two (L2) and P3 clones (48.33) at location one location (L1) (Table 3). The yield potential of cocoa is determined by its genetic nature, while actual production in the field is determined by the environment in which it grows. Conditions that are appropriate for a particular type of plant will provide a healthy appearance, with good root development so that the plant will provide high production. To be able to grow and produce well, cocoa plants want suitable land, which has certain climatic conditions and soil conditions. The temperature conditions that are suitable for cocoa plants are the average temperature between 150C - 300C, with an optimum temperature of 25.50C. The ideal height for planting cocoa is not higher than 800 m above sea level. This condition is by the location of cocoa sampling. The location for sampling cocoa is located in the Poli-Polia District of the Eastern Kolaka Regency. East Kolaka Regency is geographically located in the western part of Southeast Sulawesi Province, extending from North to South between 2º00'-5º00 'South Latitude and stretching from West to East between 120º45'-124º06 'East Longitude. The mainland region of eastern Kolaka Regency has a height generally below 1,000 meters above sea level and is located around the equator, so this area has a tropical climate with a minimum air temperature of around 10 ° C and a maximum of 31 ° C or an average of 24 ° C - 28 ° C. Based on the above, cocoa is a suitable commodity developed in East Kolaka Regency.

Table 3. Number of seeds

Location (L)	Clone (P)		
	P1	P2	P3
L1	31,40[a]	27,39[b]	48,33[a]
L2	31,78[a]	39,54[a]	41,50[b]
L3	31,73[b]	31,67[b]	27,50[c]
LSD Test$_{0.05}$	5,28		

Description: Numbers followed by the same letters in the columns (a, b, c) means that they are not significantly different from the BNT test level $\alpha = 0.05$

The average seed weight at location one (L1) the best clone is P1 (103.97 g). The best clone at location 2 (L2) is P2 (140.29 g), and the best clone at location three (L3) is P1 (100.53 g). The best locations for P1, P2, and P3 clones at L2 locations (Table 4). The number of cocoa plants that become fruit until cooked and the number of seeds in the fruit and the weight of the seeds is the factors that determine production. Based on the results of the study, the MCC02 cocoa clones had the potential to be developed from other clones because they had the number of seeds (L1P3) and dry seed weight (L2P3) the highest average of the three observation locations. This is because cocoa beans are the most used part of the plant. Cocoa beans in dry form are part of traded cocoa fruit. Parts of cocoa fruit that can be utilized, such as fruit peels, pulp, and cocoa beans (Ernianti, Zakaria, F.R. & Prisoeryanto, P.B, 2012). For generative breeding needed seeds that have a yield of 20% of the yield power of the average plant population, produce seeds with a dry weight of more than 1 gr, the fat content of more than 50% and percentage of epidermis less than 12%, resistant or tolerant to disease pests. The MCC02 clone has the advantage of elongated elliptical seeds, flat surface, dry seed weight of 1.61 grams, 12.0% seed skin content and fat content of 49.2%, resulting in an average number of fruit trees of 86.26, the number of seeds is flat fruit average 39.9 fruit values on average 14.33 production averages 2.82 kg/tree (3.132 kg/ha/ year) (DITJENBUN, 2012).

Table 4. Fresh seed weight (g)

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$103,97^{a}_{x}$	$100,03^{b}_{x}$	$90,00^{b}_{x}$	20,84
L2	$116,00^{a}_{x}$	$140,29^{a}_{x}$	$121,58^{a}_{xy}$	
L3	$100,53^{a}_{x}$	$85,33^{b}_{y}$	$57,72^{c}_{y}$	
LSD Test$_{0.05}$	16,36			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level α= 0,05

Table 5 shows that at location one (L1), the best clone for dry seed weight is P3 (23.36 g). The best clone at location 2 (L2) is P3 (35.33 g), and the best clone in location three (L3) is P2 (27.08 g) — the best location for P1, P2 and P3 clones at L2 location. Local cocoa clones are the highest cocoa clones which have the highest fruit weight and fresh seed weight (L2P2) from the three observation locations. The moisture content of seeds is a physical property that greatly influences yield, water content affects the durability of cocoa beans, especially during storage and transportation. Cocoa beans that have high water content are very susceptible to attack by fungi and insects, both of which are highly disliked by consumers because they tend to cause damage to basic tastes and aromas that cannot be repaired in the next process. The standard quality of cocoa beans for export quality is 6-7%. If it is higher than that value, cocoa beans are not safe for a long time.

Table 6. Dry seed weight (g)

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$21{,}80\,^{b}_{x}$	$19{,}00\,^{b}_{y}$	$23{,}36\,^{b}_{x}$	3,83
L2	$27{,}55\,^{a}_{y}$	$29{,}80\,^{a}_{y}$	$35{,}33\,^{a}_{x}$	
L3	$22{,}08\,^{b}_{y}$	$27{,}08\,^{a}_{x}$	$26{,}78\,^{b}_{x}$	
LSD Test$_{0.05}$	3,01			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level α= 0,05

In the field, farmers generally prefer MCC02 clones and Sulawesi 2 clones from local clones. According to the Indonesian Coffee and Cocoa Research Center (DITJENBUN, 2014), the average production of MCC02 is 2.82 kg/tree or 3.1 tons/ha/ year. The potential for production of MCC02 clones is very large when compared to other clones such as Sulawesi 1 around 1.8-2.5 tons/ha/ year and Sulawesi 2 around 1.8-2.75 tons/ha/ year.

To obtain genetic material that can be used to improve cocoa plant material, collection and exploration of cocoa germplasm need to be done by collecting local clones, introductions, or new clones from individual tree selection. The East Kolaka Regency is one of the centers of cocoa production as an exploration target to improve the genetic diversity of cocoa. Cocoa planting centers for smallholder plantations are in four provinces in Sulawesi, namely South Sulawesi 280,957 ha, Southeast Sulawesi 257,277 ha, Central Sulawesi 229,320 ha, and West Sulawesi 195,845 ha (Direktorat Jenderal Perkebunan, 2011).

D. Conclusion

The results showed that cocoa which has the potential for good yields to be developed in the East Kolaka Regency based on the analysis of the component production of dry seed weight is the MCC02 cocoa clone with an average of 35.33 grams of fruit (L2P3) respectively. The different locations show different levels of cacao yield and adaptation.

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