Potential Yield of Replanted Trees of Cocoa Clones Introduced in Lampung

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SUMMARY

In Lampung Province, Indonesia, cocoa plantation started in 1984 succeeded in increasing farmers' incomes that encourage others farmer to expand cocoa planting area using local varieties that performed low yield. Nowadays about 23% of the cocoa trees were old and needed to be replanted. The research aimed to study adaptation of 9 elite cocoa clones used as top grafted seedling in rehabilitation cocoa field in Lampung including clone Sul 1, Sul 2, Sul 3, ICCRI 3, ICCRI 7, RCC 70, RCC 71, TSH 858, and MCC 1. The results showed that those 9 national clones introduced in Lampung still did not perform a superior yield. However Clone MCC 1, ICCRI 7, and Sul 3 produced better pod number per tree and pod number per phase of fruit development. Pod structure varied among cocoa clones and showed a dynamic among months.

Introduction

Cocoa production in Lampung Province mainly located in District of Tanggamus, South Lampung, and Pesawaran. In year 2015 the yield was only 0.66 ton/ha indicating improper management practices including the use of unselected planting material and 23% of cocoa trees were more than 20 years old that need to be replanted or rejuvenated using high yield clones (Evizal et al., 2018). Farmers started planting cacao in 1984 using hybrid varieties provided by the government. This program succeeded in increasing farmers' incomes that encourage others farmer to expand cocoa planting area using local varieties that performed low yield. Recently, many stakeholders introduced national clones that superior in yield and resistant to pests and diseases such as Sul 1, ICCRI 7, MCC 1, MCC 2 (McMahon et al., 2015; Susilo et al., 2015), Sul 2, Sul 3, RCC 70, RCC 71, ICCRI 3, and TSH 858 (Evizal et al., 2016).

Material and Method

The research was conducted at Way Ratai Subdistrict, Pesawaran District of Lampung Province. Observations were made in 2017 on the population of cocoa plants in plots measuring 200 m^2 for each clone consisting of 9 clones namely Sul 1, Sul 2, Sul 3, ICCRI 3, ICCRI 7, RCC 70, RCC 71, TSH 858, and MCC 1. A cocoa field was land cleared, replanted in 2014 with grafted seedling of those national clones, spaced at 3x 3 m, and shaded with trees of Leucaena lecocephala. Farm maintenance included pruning 3 times a year, fertilizing twice a year (NPK 250 g per tree), and no spraying pesticide. For each clone, 6 trees were sampled randomly for observation. Fruit development was observed with stages of cherelle (BBHC 70-74), small pods (BBHC 75-76), big pods (BBHC 77-80), and ripe pods (BBHC 81-89) according to Niemenak *et al.* (2010). We categorised 1-10 cm long for small pod, 11-15 cm for medium and >15 cm for big pod (Prawoto, 2014). Pod production in semester II was estimated by counting all pod (small, medium, and big) in August.

Result and Discussions

The result showed that pod number during September estimation varied among clones indicating that there was different adaptation of those clone to local agro-climate. There were 5 clones produced poor pod and only MCC1 produced high number of pod and the lowest CV value indicating good adaptation, high potential yield, and low risk to grow under Lampung agro-climate.

In Lampung, number of fruit would be multiplied in the main fruiting season commonly occurred during February – August. Clones that had high pod number during low fruiting season could be expected to have more regular harvest times along the year. However pod structure of small, medium, and big pod was important to predict pod distribution as supposed by Prawoto (2014).

Table 1. Pod number in August estimation

Clone	Fruit number Semester II	CV	Yield category
Sul 2	6 ± 4,83	0,80	poor
ICCRI 3	22,5 ± 15,93	0,71	medium
ICCRI 7	10,7 ± 3,40	0,32	medium
TSH 858	1,7 ± 0,95	0,55	poor
Sul 3	20,7 ± 9,60	0,46	medium
Sul 1	13,7 ± 12,84	0,93	medium
MCC 1	32,5 ± 8,50	0,26	high
RCC 71	2,2 ± 3,20	1,42	poor
RCC 70	3,5 ± 3,78	1,08	poor

Note: < 10 poor, 10-29 medium, > 29 high

Pod structure varied among cocoa clones and months of observation. Clone TSH 858, MCC 1, and RCC 70 exhibited single pod stage while clone ICCRI 3, ICCRI 7, Sul 2 and RCC 71 had 3 pod stage in one observation. This characteristic indicated a continue fruiting that could lead to high pod production. Prawoto (2014) reported that pod structure was dynamic amog clones included Sul 1, Sul 2 and TSH 858 with major production of mature pod in Juni – November. The major season of pod production occurred during May – November. Sul 1 and Sul 2 produced more pods. Anita-Sari and Susilo (2013) reported that cocoa pod production in West Java varied among clones and months which occurred during March and June.

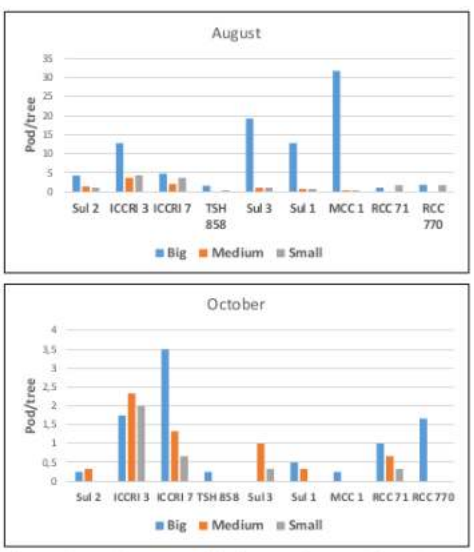

Figure 1. Pod structure in September and October

Adjaloo et al (2012) reported that floral and fruit phenology related to dry and rainy season. Cherelles and new pods was increasing during rainy season but could be distributed along the year controlled by both genetic and environmental factors. We observed that good flowering might not be followed by good new pods formation. The effectiveness of pollination might depend on pollinator activities. Falque et al (1995) reported that there was relationship between pollination intensity and fruit survival. However Frimpong-Anin et al (2014) reported that in wet season pollinated flowers were more stable (95% stability ratio) than those in dry season (65% stability ratio). N'Zi et al (2017) reported incompatibility among clones. Figure 1 showed dynamic of pod structure. Some clones continued to flower during dry season and produced new pod resulted in a complete pod phase of small, medium and big pod.

Pod number per phase of fruit development varied among clones. A complete pod phase and balance pod number per phase performed by clone ICCRI 3 especially in October observation. Clone ICCRI 3 had about 6 pods for each pod phase and lower CV value contrasted with clone MCC 1 which had 7 pods for each phase but higher CV value (Table 2). It indicated that clone ICCRI 3 produced pods more continuously while MCC 1 might have peak in August as shown by Figure 1. Pod number per phase was lower for the rest clones.

Table 2. Pod number per phase of fruit development

Clone	Pod number per phase (big, medium, small)	CV
Sul 2	2.00 ± 2.88	1.44
ICCRI 3	5.83 ± 3.45	0.59
ICCRI 7	3.50 ± 1.80	0.51
TSH 858	0.42 ± 0.53	1.26
Sul 3	5.20 ± 5.00	0.96
Sul 1	3.58 ± 2.52	0.70
MCC 1	7.33 ± 11.10	1.51
RCC 71	0.75 ± 1.66	2.21
RCC 70	1.08 ± 1.76	1.63

The yield of those 9 elite clones was under performance of superior clones due to weather extreme. Long dry season in 2015 with 5 dry months (June-October) followed by heavy wind in dry season of 2016 caused most all of mature leaves fallen, new leaves (flush) dried due to hard contact among each other, and many tip branches died. The research started when cocoa trees were just recovered in 2017. Only about 90% of the trees were survive. Therefore clones that sensitive to drought performed poor yield production and stunting growth including Sul 2, TSH 858, RCC 70 and RCC 71. Towaha and Wardiana (2015) reported that long drought had negative impact on cocoa trees growth and yield. Drought for 6 months decreased production component 5-42%.

Conclusion

Based on yield estimation in August, those 9 national clones introduced in Lampung still did not perform a superior yield. However Clone MCC 1, ICCRI 7, and Sul 3 produced better pod number per tree and pod number per phase of fruit development. Pod structure varied among cocoa clones and showed a dynamic among months.

Acknowledgement

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