Yield Results Evaluation of Local Coffee Clones Tanggamus – Lampung

Rr. Ernawati[1,*] Nila Wardani[1] Agung Lasmono[2] Meidaliyantisyah[3]
Dian Meithasari[4]

[1] *Research Center of Horticulture and Plantation Commodity, National Agency of Resesearch and Innovation of Indonesia*
[2] *Lampung Assessment Institute for Agricultural Technology*
[3] *Research centre for Sustainable Production System and Life Cycle Assessment, National Research and Innovation Agency of Indonesia*
[4]*Research Center of Food Commodity, National Agency of Research and Innovation of Indonesia*
[*]*Corresponding author. Email: ernawati5903@yahoo.co.id*

ABSTRACT
Superior varieties are one of the components that play an important role in increasing agricultural products. One of the efforts to increase the production of coffee plants, among others, is introducing several local coffee clones that can be used as options in the development of coffee cultivation. This study aimed to evaluate the yield of local coffee growing in Tanggamus Regency, Lampung compared to national superior varieties. The research was carried out at the farmer's coffee plantation, Way Harong Village, Air Naningan District, Tanggamus-Lampung - Indonesia, from January 2018 to October 2019. The method used was a demonstration plot with a randomized block design with four replications. The six local coffee clones evaluated were: *Kuning*, *Kasio*, *Hijau*, *Komari*, *Randu Alas*, and *Sailing* coffee compared to the national superior variety coffee, SA 237. The evaluation of local coffee yield was aimed at the character of the number of production branches per plant, number of coffee cherries per productive branch, number of coffee cherries per coffee bunch, weight per dry bean, and yield of dry beans per plant. Evaluation in the second year (2019) was done after the plants received technological improvements with fertilization. The results which were analyzed using the analysis of variance (ANOVA) with the mean BNT test at the 5% level showed that among the six local coffee clones studied had very significantly different characteristics. The local clone Komari had the highest yield close to the national superior coffee yield, SA 237, while Sailing had the lowest yield.

Keywords: *evaluation, yield, clone, local coffee, Tanggamus, Lampung, Indonesia.*

1. INTRODUCTION

Coffee is the main plantation commodity in Indonesia. Coffee plantations in Indonesia are mostly Robusta coffee, which are smallholder coffee plantations (96.06%) involving 1.7 million farmers [1]. According to Defitri [2], the role of Robusta coffee has a strategic value in the context of empowering the people's economy. In Indonesia today, the demand for coffee continues to increase both domestically and internationally, the rate of increase in consumption is higher than the rate of production. The domestic coffee growth rate is 8% per year, while the production growth per year is only 2% [3].

Lampung is one of the main Robusta coffee-producing provinces. In 2018 the total area of Robusta coffee in Lampung was 161.162 ha with production reaching 133,243 tons or a productivity of 8.26 quintal per hectare [4]. According to Darwis [5], the Tanggamus-Lampung Regency is included in the area development location stipulated in the Decree of the Minister of Agriculture Number 472 of 2018. Robusta coffee is generally developed in the low to medium lands (0–700 m asl), but Robusta coffee quality (fenest Robusta) is produced in the highlands. According to

© The Author(s) 2023
A. D. Saputro et al. (Eds.): ICOSEAT 2022, ABSR 26, pp. 76–81, 2023.
https://doi.org/10.2991/978-94-6463-086-2_11

Camargo [6] and Joët et.al. [7], altitude is one of the factors that affect the growth, quality, and taste of coffee plants. The difference in altitude is closely related to changes in temperature. For every 1,000 meters increase in altitude, there will be a decrease in temperature of 6.5ºC [8] or an average of 0.65ºC per 100 meters. The decrease in temperature has the greatest impact on changes in plant physiology [9]. In addition, higher elevations also have a lower oxygen content so that the coffee cherries ripen more slowly. These conditions trigger the formation of coffee beans with better aroma and taste characters [10]. However, according to Rahardjo [11], coffee plants if the cultivation system is implemented properly will result in production with high yield quality. One of them is by improving plant genetic material. Increasing the productivity of coffee plantations by improving plant genetics can be done by encouraging the selection and utilization of various specific-location local clones. Local coffee is a genetic resource that needs to be protected and preserved. To find out the genetic potential, identification/characterization is needed to evaluate the good characters that appear in an environment [12].

Table 1. Chemical properties of the research site in Wayharong Village, Air Naningan District, Tanggamus Regency, Lampung, Indonesia.

Soil Chemical Properties	Value (2018)	Value (2019)
pH : H_2O	5.20	5.48
KCl	4.63	4.62
% C Organic	1.56	1.71
% Nitrogen	0.12	0.18
P_2O_5 available (ppm)	5.54	29.79
K_2O available (ppm)	30.43	35.81
P Potential (mg P2O5 per 100 g)	23.15	55.81
K Potential (mg K2O per 100 g)	33.07	32.53
Exchangable Acidity (C mol/kg): Al-e	0.41	0.37
H-e	0.44	0.46
K-e (C mol/kg)	0.38	0.47
Na-e(C mol/kg)	0.59	0.51
Ca-e (C mol/kg)	5.23	4.85
Mg-e (C mol/kg)	1.50	1.07
CEC (C mol/kg)	15.69	16.12

Source: The results of the analysis at the Natar IP2TP Laboratory, South Lampung (2018 and 2019)

The aim of this study was to evaluate the generative character of the yield components of several local coffee clones in Tanggamus, as a clone that is considered to be adaptive in the local area because it has been planted on average at least 12 years ago from generation to generation. Therefore, information on the yield of several local clones is deemed necessary to determine their potential. From these results, it is hoped that there will be prospective local clones of coffee that have the potential to excel. The superior characteristics of the local clones of Tanggamus coffee that became the basis for the selection/evaluation were those with high yield potential when compared to the national superior coffee varieties.

2. MATERIALS AND METHODS

The research was carried out from January 2018 to October 2019 at the location of coffee farmers in Wayharong Village, Air Naningan District, Tanggamus-Lampung-Indonesia Regency with an altitude of about 350 m above sea level. The soil type at the research site was red yellow podzolic (PMK) and the chemical properties of the soil were analyzed at the Soil Laboratory of Lampung Assessment Institute for Agricultural Technology (Lampung AIAT) (Table 1).

The materials used in this study were: 6 local coffee clones of Tanggamus evaluated (*Kasio*, *Kuning*, H*ijau*, *Komari Randu Alas*, and *Sailing*), are the parent trees of local coffee clones planted by farmers in Tanggamus - Lampung, and have been registered for its protection as a registered local variety at the Center for Plant Variety Protection and Agricultural Licensing (PPVTPP) Jakarta. As a comparison, coffee clone that had been used was a national superior coffee variety, SA 237. The study used a randomized block design with four replications. Six local coffee clones and one comparison variety SA 237 as treatments and 4 parent plants/trees of each local coffee clone were observed as well as replicates. Observation data in the form of generative characteristics of coffee as a component of yield consisting of the number of productive branches per plant, the number of coffee bunches per productive branch, and the number of fruits per bunch. To determine the yield potential, yield data were collected consisting of dry coffee production per tree and dry bean weight. Plant maintenance carried out in the form of liming using Dolomite 1kg per tree, adding nutrients by giving 10 kg of fermented manure per tree, 400 gr of urea per tree, 240 gr of Rock Phosphate per tree, and 320 gr NPK fertilizer per tree, which was given in April 2018 and April 2019.

Analysis of the data by means of ANOVA and continued with the mean value test using LSD at a 5% significance level [13].

3. RESULTS AND DISCUSSIONS

3.1. Robusta Coffee Generative Characters in Tanggamus

The results of the generative character analysis showed that among the coffee clones evaluated, there were significant differences in both 2018 and 2019 observations (Table 2). These differences indicate that there are genotype variations between one individual and another [14]. Table 2 shows that the average results of observations of the generative character of the number of productive branches, the number of coffee bunches per productive branch, and the number of fruits per bunch in the first year (2018) increased in the second year (2019). The superior variety of SA 237 coffee has the highest number of productive branches and the number of coffee bunches per productive branch compared to 6 clones local coffee tested, but for the character of the number of fruits per bunch the highest was the Komari local coffee clone (Table 2). This indicates that among the local coffee clones evaluated, the local Komari coffee clone has the best generative character and has high potential approaching the high yielding variety SA 237 coffee.

Table 2. Results of processing the generative character data for several Robusta coffee clones in Tanggamus 2018 and 2019

Robusta coffee clone	Generative Characteristics					
	Productive branch number		Coffee bunches per productive branch		Fruit per bunch	
	2018	2019	2018	2019	2018	2019
Kasio	22.0 [b]	24.0 [b]	7.5 [bc]	7.0 [d]	16.25 [bc]	18.0 [b]
Kuning	19.25 [c]	26.0 [b]	7.75 [bc]	8.0 [cd]	17.25 [b]	17.25 [b]
Hijau	17.25 [d]	19.0 [c]	6.75 [cd]	7.0 [d]	13.0 [d]	14.0 [c]
Komari	16.0 [d]	18.0 [c]	8.0 [b]	8.25 [bc]	20.0 [a]	20.0 [a]
Randu Alas	13.75 [f]	14.0 [d]	6.25 [cd]	8.75 [bc]	19.75 [a]	20.0 [a]
Sailing	14.75 [f]	14.75 [d]	5.25 [d]	9.0 [b]	15.0 [cd]	15.0 [c]
SA 237	32.0 [a]	35.5 [a]	10.75 [a]	15.5 [a]	10.0 [e]	14.75 [c]
CV/KK (%)	19.7	21.5	15.9	18.6	20.2	20.6

Note: the numbers followed by the same letter are not significantly different in LSD test at 5% level.

3.2. Coffee Yield

Yield evaluation was the basis for selecting the superiority of the coffee clones tested, coffee with high yield potential was identified if the value is higher than the national superior coffee variety. The character of high yield potential is one of the important characters that must be possessed by a superior coffee clone/variety [15]. Table 3 shows an increase in yield from the first year (2018) to the second year (2019), so the superiority of the yield of local coffee clones can be seen in the second year (2019), which were Komari and Kuning local clones coffee had higher yield than the SA superior variety (SA 237), and the highest was Komari. These results indicate that local Komari and Kuning coffee clones can be used as genetic material with high yields, to increase the diversity of site-specific local clones. This is in line with the results of the research by Evizal and Prasmatiwi [16] which stated that the use of a variety of local clones of specific, site-specific coffee with high yield can encourage genetic improvement and increase the productivity of coffee plantations.

This increase in yield may also be influenced by the growing environment that had been done by improving cultivation techniques for plant maintenance, in the form of liming and fertilizing both fermented manure fertilizers and inorganic fertilizers. Cultivation techniques and growth compatibility are environmental factors that can affect high coffee yields [17]. The results of Pujiyanto's research [18] showed that the application of 13.5 kg of cow manure per tree significantly increased coffee production by more than 33% per year. Furthermore, according to Da Matta, et.al. [19] the condition of elite Robusta coffee clones in Brazil with intensive plantation management was able to produce 12 tons ha^{-1}.

Table 3. The results of data processing of yield and bean weight of several Robusta coffee clones in Tanggamus-Lampung, 2018 and 2019

Robusta coffee clone	Dry Coffee bean yield per plant (kg)		Dry Coffee bean weight (gr)	
	2018	2019	2018	2019
Kasio	1.52 [c]	3.12 [b]	1.11 [d]	1.30 [bc]
Kuning	1.65 [b]	4.99 [a]	1.13 [cd]	1.40 [b]
Hijau	1.33 [c]	2.28 [b]	1.12 [d]	1.20 [bc]
Komari	1.73 [b]	5.12 [a]	1.20 [b]	1.73 [a]
Randu Alas	1.43 [d]	3.02 [b]	1.18 [bc]	1,18 c
Sailing	1.28 [e]	2.40 [b]	1.20 [b]	1.20 [bc]
SA 237	2.14 [a]	4.50 [a]	1.28 [a]	1.28 [bc]
CV/KK (%)	6.09	6.09	6.06	6.20

Note: the numbers followed by the same letter are not significantly different in LSD test at 5% level.

The increase in the yield of coffee studied from the first year (2018) to the second year (2019) showed that there was a responsiveness of plants to the environment, with the maintenance of plants and efforts to improve the garden with the provision of dolomite and organic

(fermented manure) and inorganic fertilizers in the coffee garden which had a good effect and there was an increase in the development of productive characters. Provision of manure in the long term can increase the content of macro and micronutrient [20], increase particulate organic carbon and dissolved organic carbon [21]. Other functions of manure are increasing the C-organic nitrogen of the soil, and can improve aggregate stability, porosity, and soil moisture content [22]. The application of manure and inorganic mineral fertilizers has a better effect on soil quality [23]. In line with the research results of Kidanemariam et.al. [24] and Cyamweshi, et.al., [25], increased coffee fruit yield was positively correlated with pH, total N, P, and K available in the soil. This increase also found in this study results of the analysis of the soil where the activity was carried out (Table 1).

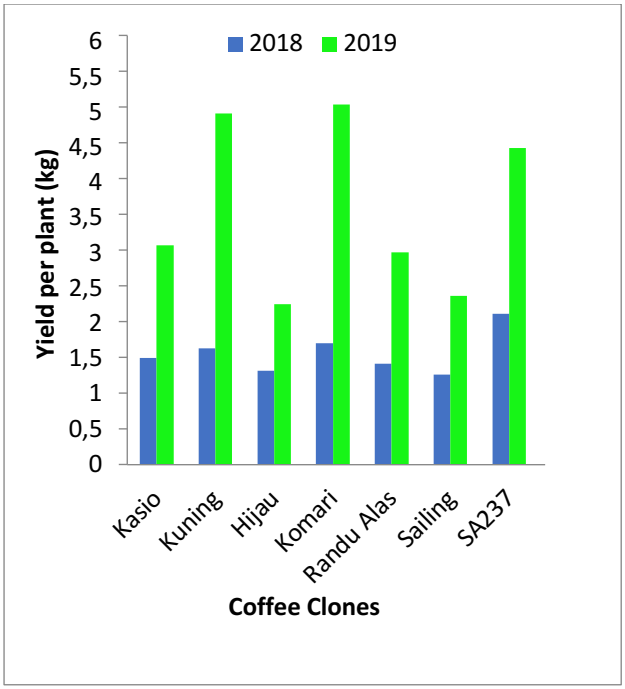

Figure 1 Performance of Coffee Clones

The element N is the main limiting factor for the growth of coffee plants [26]. Lack of N elements will cause plant vegetative growth to be [27]. Element P has an important role in generative growth and yield components. The availability of sufficient P will be well absorbed by plants so that the generative growth and components of the yield are optimal. In addition, organic C and N content were positively correlated with normal seeds [28].

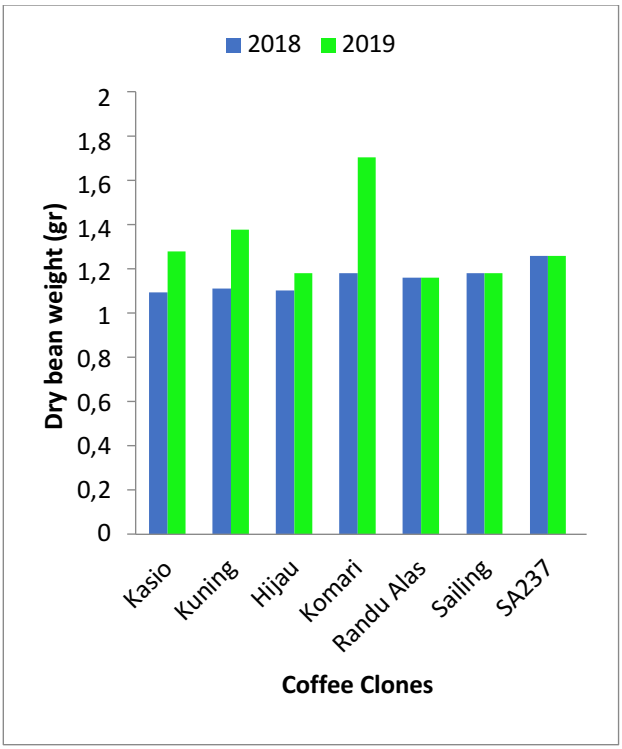

Figure 2 Performance of coffee's dry bean weight

4. CONCLUSION AND SUGGESTION

The evaluation of the yield of several local Robusta coffee clones in Tanggamus showed that the best coffee was the Komari clone which had higher number of fruits per bunch, dry bean weight, and production per tree compared to the national superior variety SA 237. It is suggested that local coffee clones can be proposed as national superior varieties

AUTHORS' CONTRIBUTIONS

Conceptualization, E; methodology, E, N.W., and M; formal analysis, A.L. and D.M.; writing-original draft preparation and visualization, E and M; review-editing, E, M, and N.W.; writing - review and editing, E and M.

ACKNOWLEDGMENTS

High appreciation to the farmers and the community in Way Harong Village, Air Naningan District, Tanggamus Regency who have assisted in carrying out the research.

REFERENCES

[1] Central Bureau of Statistics, Indonesian coffee statistics 2018. Central Statistics Agency (BPS) Statistics Indonesia, 2019, Catalog: 550 4006.ISBN: 978 -602-438-297-1

[2] Y. Defitri, "Pengamatan beberapa penyakit yang menyerang kopi (Coffea, sp) di Desa Mekarjaya

Betasai Kecamatan Tanjung Jabung Barat" [in Bahasa], Media Pertanian 1(2) (2016) 78-84.

[3] AEKI, Konsumsi kopi dalam negeri alami pertumbuhan hingga 8 persen setiap tahun, Bisnis com, 2019.

[4] Directorate General of Plantation, Indonesian Plantation Statistics, Coffee Commodity 2018 – 2020. Secretariat of the Directorate General of Plantations. Jakarta, 2019

[5] V. Darwis, Y.H. Saputra, C. Muslim, "Keragaan dan Pengembangan Agribisnis kopi Robusta di Lampung", Food System and Agribusiness 4(2) (2020), 83-91.

[6] M.B.P. De. Camargo, "The impact of climatic variability and climate change on Arabic coffee crop in Brazil", Bragantia, 69 (2010) 239–247. DOI: https://doi.org/10.1590/80006-87052010000100030

[7] T. Joët, A. Laffargue, F. Descroix, S. Doulbeau, B. Bertrand, A. De Kochko, S. Dussert, "Influence of environmental factors, wet processing and their interactions on the biochemical composition of green Arabica coffee beans. Food Chemistry", 118(3) (2010) 693–701. DOI: https://doi.org/10.1016/j.foodchem.2009.05.048.

[8] M. Cavcar, The International Standard Atmosphere (ISA), Anadolu University, Turkey, 2000, Retrieved from http://www.wxaviation.com/ISAweb-2.pdf.

[9] S.C. Thomas, "Genetic vs phenotypic responses of trees to altitude", Tree Physiology 31(11) (2011) 1161–1163. Doi: https://doi.org/10.1093/treephys/tpr105

[10] V. Sridevi, P. Giridhar, "Changes in caffeine content during fruit development in Coffea canephora P.ex.Fr.grown at different elevations", Biology and Earth Science 4(2) (2014), 168 – 175.

[11] P. Rahardjo, Panduan Budidaya pengolahan kopi Arabika – Robusta, in: Q.D. Trias (ed.) Jakarta (ID), Panebar Swadaya, 2012

[12] Priyono, Mawardi, Seleksi genotipa-genotipa unggul *Coffea canephorapada* populasi bastar terkontrol [in Bahasa]. Pelita Perkebunan 23(2) (2007) 3-7.

[13] K.A. Gomez, A.A. Gomez, Prosedur Statistik Untuk Penelitian Pertanian [in Bahasa], 2nd Edition, UI Press, Jakarta, 2010.

[14] Muhsanati, Lingkungan fisik tumbuhan dan agroekosistem menuju system pertanian berkelanjutan, Andalas University Press, Padang, 2012.

[15] Syafaruddin, Dani, M.B. Pabendon, "Keragaman genetic antar klon kopi Robusta local Pagar Alam berdasarkan analisis Marka SSR" [in Bahasa], JTIDP 4(3) (2017) 133 - 144.

[16] R. Evizal, F.E. Prasmatiwi, "Pertanian Spesifik Lokasi. Etnoagronomi ragam kopi grafting di Lampung. Barat" [in Bahasa]. Agrotek Tropikal 8(2) (2019) 423–434.

[17] R. Evizal, "Etnoagronomi pengelolaan perkebunan kopi di Sumberjaya Lampung Barat" [in Bahasa], Agrotek Tropikal 3(2) (2013) 1- 2.

[18] P. Pujiyanto, "Use of surface soil water in Robusta coffee field through organic matter wicks", Pelita Perkebunan, 27(3) (2013) 191 - 203.

[19] F.M. Da Matta, C.P. Ronchi, M. Maestri, R.S. Barros, "Ecophysiology of coffee growth and production. Brazilian", Plant Physiology, 19(4) (2017) 485-510. DOI:10.1590/516770420201700040014

[20] M.A.A. Bakry, R.A. Yaser, Solaeman, S.A. Moussa, "Importance of micronutriens, organic manure and biofertilizer for improving maize yield and its component grown in deserts sandy soil", Agriculture and Biological Sciences 5(1) (2009) 16-23.

[21] E. Liu, C. Yan, X. Mei, Y. Zhang, T. Fan, "Long Term effect of manure and fertilizer on soil organic carbon ppls in dry land farmin in Northwet China", Plos One 8(2) 2013 http://doi.org/10.137/journal.phone.0056536

[22] M. Zulkarnain, B. Prasetya, Soemarno, "Pengaruh kompos, pupuk kendang, dan custom-bio terhadap sifat tanah, pertumbuhan dan hasil tebu (Saccharum officinarum L.) pada entisol di kebun Ngrangkah-Pawon, Kediri. Indonesian" [in Bahasa], Green Technology 2(2) (2013) 45 – 52.

[23] T. Simon, A. Czako, "Influence of long term application of organic and in organic fertilizers on soil properties", Plant Soil Environment 60(7) (2014) 314 -319.

[24] A. Kidanemariam, H. Gebrekidan, T. Mamo, K. Kibret, "Impact of altitude and land use type on some physical and chemical properties of acidic soils in Tsegede", Soil Science (2012) 223–233. doi: https://doi.org/10.4236/ojss.2012. 23027

[25] R.A. Cyamweshi, N.L. Nabahungu, A. Mukashema, V. Ruganzu, M.C. Galtarayiha, A. Nduwumuremyi, J.J. Mbonigaba, "Enhancing

nutrient availability and coffee yield on acid soils of the central plateuau of southern Rwanda", Agricultural Research 2(2) (2014) 44–55.

[26] D.M. Lima, S.M. de Lindomar, A.T. Marcelo, F.T. do A. Jose, "The nutritional efficiency of Coffea spp. A review." African Journal of Biotechnology 14(9) (2015) 728–734. doi: https://doi.org/10.5897/AJB2014.14254

[27] M.H. Aminifard, H. Aroice, H. Nemati, M. Azizi, M. Khayyat, "Effect of nitrogen fertilizer on vagetatif and reproductive growth of pepper plants under field conditions" Plant Nutrition 35(2) (2014) 235-242. doi: https://doi.org/10.1080/01904167.2012.636126

[28] B. Bertrand, R. Boulanger, S. Dussert, F. Ribeyre, L. Berthiot, F. Descroix, and T. Joët, "Climatic factors directly impact the volatile organic compound fingerprint in green Arabica coffee bean as well as coffee beverage quality". Food chemistry 135(4) (2012) 2575-2583.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.