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The influence of coffee clones and postharvest methods on the physical quality of eight clones of local robusta coffee in West Lampung, Indonesia

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Abstract. *Analianasari, Murhadi M, Nurdin SU, Utomo TP, Suhandy D. 2023. The influence of coffee clones and postharvest methods on the physical quality of eight clones of local robusta coffee in West Lampung, Indonesia. Biodiversitas 24: 5779-5787.* One of the qualities of coffee is a physical characteristic that can be seen directly as a determinant of the coffee bean's price. This study consisted of eight clones of robusta coffee picked red, which was processed using the postharvest method (natural, honey, and full wash) with three repetitions, then evaluated based on the physical attributes of the coffee beans (moisture content, weight of 100 coffee beans, length and the width of the coffee beans, the percentage of passing through the Sieve, and the number of coffee bean defects). The results showed that most of the physical quality parameters of clones from local Robusta coffee varieties were carried out using the postharvest method and planted in West Lampung statistically different ($P<0.05$). The moisture content in naturally processed tugu sari clones had a higher moisture content, but it was not different from the srintil clones in all postharvest processing. All clones can produce specialty (fine) and premium quality coffee beans based on the quality of the physical attributes. However, dry processing (natural and honey) fine coffee clones provide the best quality physical attributes. The findings from this study were that the diversity of cloned robusta coffee with various postharvest methods provides information that indicators of local genetic diversity had different physical attributes, but more significant and repeated experiments are needed to obtain accurate results.

Keywords: Physical attributes, postharvest, robusta coffee

INTRODUCTION

Coffee is the most consumed drink in the world. World coffee consumption growth is projected to grow by 3.3% to 10.200 thousand tons in 2021/2022 compared to 2020/2021, of only 9.900 thousand tons (ICO 2022). The increased growth in coffee consumption shows that the development of coffee is in demand by all groups, thus creating new market segmentation. The formed market segmentation creates opportunities for coffee-producing countries and increases market competition. Market competition can be won if producers maintain coffee quality. The quality of coffee is influenced by water content, physical aspects, chemical aspects of the coffee beans, and the taste of coffee (Cheng et al. 2016).

Indonesia is known as the fourth largest coffee producer in the world, with a production of 565 thousand tons, and 70% is robusta coffee (ICO 2020). Robusta coffee plants were developed from introduced plants with the highest coffee genus variability (Motta et al. 2014). Robusta coffee clones result from a cross between two or more robusta coffee plants with desired characteristics (Ramadiana et al. 2018). Tugu sari robusta coffee clones (BP 534) by West Lampung farmers are always cultivated to help the pollination process of local robusta coffee clones in one cultivation area. The BP 534 clone contributed 41-80% genetic similarity to the West Lampung and Tanggamus robusta coffee clones (Ramadiana et al. 2021). The diversity of robusta coffee clones in Lampung has identified as many as 25 (Evizal 2015).

West Lampung's local clone, robusta coffee has been introduced as Lampung's flagship coffee in 2019, namely Korolla 1, 2, 3, and 4, with high production and resistance to coffee berry borer (PBKo), leaf rust resistance, and taste with a score of 78.58 and 82.33 with excellent and fine criteria (Udarno 2019). Ramadiana et al. (2018) reported a diversity of coffee bean characteristics of robusta coffee clones from Tanggamus and West Lampung. The diversity of Robusta coffee clones resulting from the innovation of farmers in West Lampung, which have advantages in terms of production, disease resistance, and taste. The characteristics possessed by robusta coffee clones have the potential to produce premium coffee.

Premium coffee is generally produced from small farms with unique climates and managed by farmers with a creative spirit and innovation (Peterson 2013). Premium coffee is produced from the postharvest handling process following predetermined standards (Hameed et al. 2018)

(Belay et al. 2016). The physical quality of coffee beans is essential in implementing the postharvest technology that will be used. There are two postharvest processes farmers use: dry processing (natural and honey) and wet processing (full wash) (Analianasari et al. 2023).

Proper postharvest handling at each stage will produce good-quality coffee beans (Yusibani et al. 2022). Postharvest processing is essential in producing high-quality coffee (Rodriguez et al. 2020; Anacona et al. 2022). These key factors are present in each stage of the postharvest coffee processing process, such as the red fruit picking stage, the floating process, the pulping, and the drying process delaying the postharvest process stages delays at each stage also cause a decrease in the quality of coffee bean and taste. In addition, delaying the process of coffee beans can cause aerobic fermentation (Maman et al. 2021).

Moreover, research has been widely carried out focusing on postharvest techniques as an essential factor in determining the quality of drinks, emphasizing perfectly ripe cherries and coffee bean drying methods (Pereira et al. 2020; Silva et al. 2022). The physical quality of the differences in postharvest processing methods for eight local Robusta coffee clones in West Lampung needs to be studied for characteristics to produce the physical quality of coffee beans. Therefore, this study aims to analyze the physical characteristics, which include moisture content, size, length, and width of the coffee beans, the weight of 100 coffee beans, the uniformity of coffee beans (passing the Sieve), and the number of coffee bean defects from the differences in postharvest methods and local robusta coffee clone, West Lampung, Indonesia. The physical quality of eight local robusta coffee clones with different postharvest methods is essential as information for compiling a West Lampung local Robusta coffee breeding program that has the potential to produce physical quality characters that contribute to high taste quality.

MATERIALS AND METHODS

Study area

The raw material for coffee beans as a sample was selected by purposive sampling on farmer plantations in one ecosystem location with an altitude of 900 meters above sea level (masl), has a granular soil texture, soil acidity degree (pH) 4, average rainfall 2000 mm/t, located in Tribudisyukur Village, Kebun Tebu District, West Lampung, Lampung, Indonesia (Figure 1).

Coffee bean ingredients

The raw material for Robusta coffee beans consists of eight clones from local Robusta coffee clones: ciari, egawa, srintil, rope dale, tugu hijau, tugu sari, rope dora, and rona, which are processed using the postharvest method: natural, honey, and full wash (Figure 2).

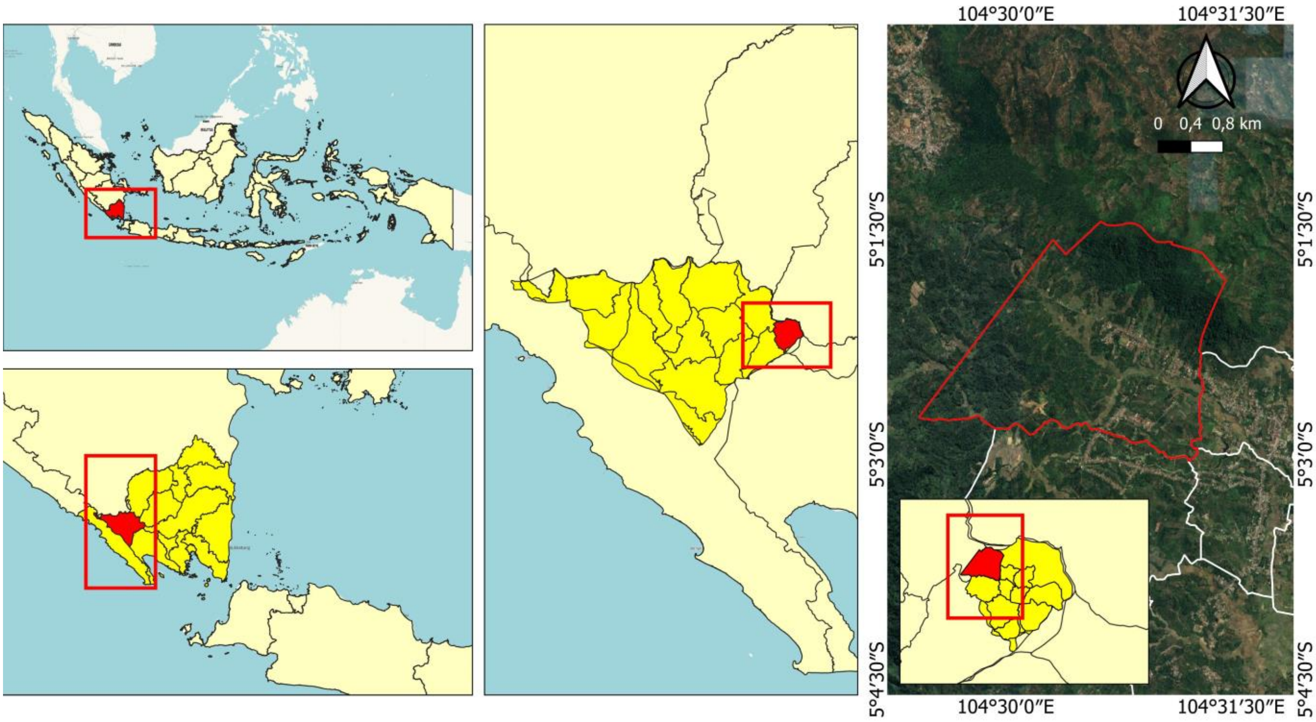

Figure 1. Map of research locations in Tribudisyukur Village, Kebun Tebu District, West Lampung, Lampung, Indonesia

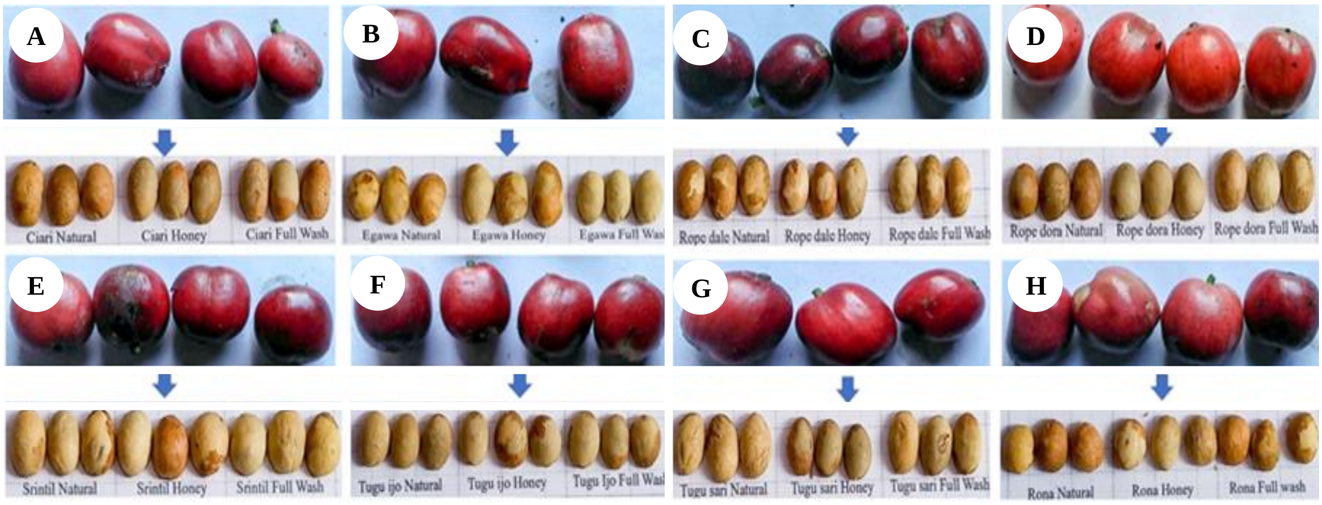

Figure 2. Cherry fruit of robusta coffee beans clones which were processed using three postharvest methods (natural, honey, and full wash). A. Ciari, B. Egawa, C. Rope Dale, D. Rope Dora, E. Srintil, F. Tugu Hijau, G. Tugu Sari, H. Rona

Procedures

Sub-procedures-1

The harvesting technique used is selective harvesting, namely fruit that has a maturity level of 95% red fruit. This study used a completely randomized design with the treatment of eight local robusta coffee bean clones: ciari, egawa, srintil, rona, rope dale, rope dora clone, tugu hijau, and tugu sari, which were processed using three postharvest methods: natural, honey, and full wash to obtain twenty-four treatments. The sample to be used is 3,000 g for each sample.

Sub-procedures-2

Green coffee beans from eight clones with different postharvest methods were carried out in stages of observing the attributes of the physical quality of the coffee beans, namely observing the moisture content of the coffee beans based on the recommendations of the (AOAC 2005), the weight of coffee beans at 100 coffee beans (g) based on recommendations by Sualeh and Mekonnen (2015). Furthermore, coffee bean quality calculation on the number of coffee bean defects with two specialties and premium grade criteria based on the SCAA (Kosalos et al. 2013), the size of the coffee beans (length and width (mm), and the coffee beans that passed the Sieve (%) were weighed to determine size trends based on clones and postharvest methods and classified into large grains (Sieve no 19), medium grains (Sieve no 16), and small grains (Sieve no 14) (Badan Standarisasi Nasional 2019).

Data analysis

Physical attribute data from three replicates were expressed as mean ±SD and analyzed by ANOVA using the SPSS statistic 20 using 5% HSD. Next, we use MS Excel to generate a bar chart for all parameters with their standard deviations. Several images are displayed and analyzed descriptively.

RESULTS AND DISCUSSION

Robusta coffee, with eight clones on land at an altitude of 900 masl in Tribudisyukur Village, Kebun Tebu District, West Lampung, has various physical characteristics of green coffee beans. The physical characteristics of coffee beans include coffee bean moisture content, coffee bean size (length and width), and coffee bean defects (Girma 2020). These physical characteristics are determinants of coffee quality for the coffee industry besides aroma, taste, and acidity (Giomo et al. 2012). The physical attributes of coffee beans are shown in Table 1.

Moisture content

The moisture content in all clones with different postharvest methods was below 2.5% (Badan Standarisasi Nasional 2019). Table 1 shows that the moisture content is lower than the standard, ranging from 6.28-10.34, indicating that the moisture content of coffee beans meets the SNI 01-2907-2008 standards. The robusta coffee beans' moisture content of the tugu sari clone with natural postharvest processing produces a moisture content close to 12% of 10.3%. The resulting moisture content is not significantly different from the moisture content of the srintil clones in all postharvest processes, ranging from 9.3 to 9.6%, and rope dale clones in the full wash postharvest process of 9.5%. The lowest moisture content was produced by the Tugu Hijau clone in the full wash postharvest process of 6.3% and did not differ from the moisture content produced by the ciari clone in the full wash postharvest process of 6.4%. Coffee beans with a 10-12% moisture content can avoid unwanted fermentation processes (Rodriguez et al. 2020). However, the overall moisture content data meets the requirements of SNI 01-2907-2008, which is below 12.5%.

Table 1. Physical attributes of coffee beans from eight robusta coffee clones with three postharvest methods (natural, honey, and full wash)

Clones	Processing	Moisture content (%)	Weight 100 seeds (g)	Length coffee bean (mm)	Width coffee bean (mm)	Passed sieve (%)	Defect value
Ciari	Natural	7.06 ^{ghij}	35.30 ^{b}	13.52 ^{abcd}	8.82 ^{ab}	2.75 ^{ijk}	6,50 ^{ef}
Ciari	Honey	8.27 ^{cdef}	34.50 ^{bc}	14.29 ^{ab}	8.30 ^{abcd}	3.05 ^{hijk}	12.90 ^{a}
Ciari	Full wash	6.44 ^{j}	31.80 ^{d}	13.54 ^{abcd}	7.29 ^{d}	50.42 ^{a}	4.60 ^{fghij}
Egawa	Natural	8.03 ^{defgh}	29.90 ^{ef}	14.06 ^{abc}	7.54 ^{cd}	6.40 ^{fghij}	5.30 ^{efg}
Egawa	Honey	8.34 ^{cdef}	29.00 ^{fgh}	14.67 ^{a}	8.05 ^{bcd}	8.28 ^{fghi}	5.20 ^{efgh}
Egawa	Full wash	8.92 ^{bcd}	29.50 ^{f}	13.55 ^{abcd}	7.29 ^{d}	31.87 ^{c}	3.85 ^{ghij}
Rope dale	Natural	8.47 ^{bcdef}	23.70 ^{m}	11.70 ^{cdef}	8.31 ^{abcd}	12.30 ^{ef}	7.20 ^{de}
Rope dale	Honey	8.84 ^{bcd}	25.40 ^{l}	10.92 ^{ef}	8.30 ^{abcd}	9.76 ^{fg}	2.55 ^{j}
Rope dale	Full wash	9.53 ^{ab}	27.10 ^{ijk}	11.42 ^{def}	7.30 ^{d}	10.47 ^{efg}	11.25 ^{ab}
Srintil	Natural	9.59 ^{ab}	39.30 ^{a}	13.25 ^{abcd}	9.62 ^{a}	0.77 ^{jk}	3.10 ^{hij}
Srintil	Honey	9.33 ^{abc}	31.90 ^{d}	12.99 ^{abcdef}	9.38 ^{ab}	0.40 ^{k}	2.60 ^{j}
Sritil	Full wash	9.34 ^{abc}	33.40 ^{c}	13.00 ^{abcdef}	9.64 ^{a}	7.52 ^{fghi}	4.80 ^{fghi}
Tugu hijau	Natural	8.02 ^{defgh}	26.90 ^{jk}	11.44 ^{def}	8.30 ^{abcd}	7.82 ^{fghi}	4.00 ^{ghij}
Tugu hijau	Honey	6.93 ^{hij}	29.20 ^{fg}	11.70 ^{cdef}	8.05 ^{bcd}	7.07 ^{fghi}	3.85 ^{ghi}j
Tugu hijau	Full wash	6.28 ^{j}	28.30 ^{ghi}	11.95 ^{bcdef}	7.99 ^{bcd}	7.07 ^{fghi}	4.10 ^{ghij}
Tugu sari	Natural	10.33 ^{a}	27.90 ^{hij}	13.01 ^{abcdef}	8.31 ^{abcd}	6.85 ^{fghi}	10.65 ^{bc}
Tugu sari	Honey	7.43 ^{fghij}	26.20 ^{kl}	11.69 ^{cdef}	7.55 ^{cd}	8.85 ^{fgh}	6.60 ^{ef}
Tugu sari	Full wash	7.66 ^{efghi}	26.10 ^{kl}	11.98 ^{bcdef}	8.32 ^{abcd}	16.27 ^{de}	8.75 ^{cd}
Rope dora	Natural	6.52 ij	30.80 ^{de}	10.91 ^{ef}	8.33 ^{abcd}	5.42 ^{ghijk}	2.75 ^{ij}
Rope dora	Honey	7.42 fghij	29.00 ^{fgh}	10.65 ^{ef}	8.36 ^{abcd}	7.75 ^{fghi}	2.85 ^{ij}
Rope dora	Full wash	8.85 ^{bcd}	31.70 ^{d}	11.42 ^{def}	8.38 ^{abcd}	42.20 ^{b}	3.05 ^{ij}
Rona	Natural	8.19 ^{cdefg}	25.40 ^{l}	11.19 def	8.59 ^{abcd}	8.67 ^{fghi}	3.55 ^{ghij}
Rona	Honey	9.07 ^{bcd}	25.70 ^{l}	11.71 cdef	8.34 ^{abcd}	9.12 ^{fg}	3.15 ^{hij}
Rona	Full wash	8.81 ^{bcde}	22.00 ^{n}	11.17 def	8.09 ^{bcd}	21.45 ^{d}	5.50 ^{efg}
HSD		1.16	1.19	2.53	1.39	5.95	2.10

Note: There is no significant difference in the column followed by the same letter, HSD 5%

Weight of 100 coffee beans (g)

The weight of 100 coffee beans of the natural process srintil coffee clone has the highest weight value among the clones and showed significant differences from all postharvest treatments with a weight of 39.3 g, followed by ciari clones in the natural postharvest process, honey of 35.3 g, and 34.5 g. In contrast, with the weight of 100 seeds, the lightest coffee was found in rona clones with full wash postharvest processing of 22 g (Table 1).

Coffee bean size

The analysis of the length and width of the coffee beans in each clone is shown in Table 1. The length of the coffee beans significantly differed between clones and postharvest methods, ranging from 10.65 mm to 14.67 mm. The coffee bean size with the highest length was found in the egawa clone with honey processing of 14.67 mm, and the shortest in length is the rope dora clone with honey processing of 10.65 mm.

Analysis of variance in the size of coffee bean widths on different coffee clones and postharvest methods showed differences in coffee bean widths ranging from 7.29 mm - 9.64 mm. The widest coffee bean width was observed in srintil clones in all postharvest methods (9.64 mm), and the thinnest coffee bean width was observed in egawa clones with full wash processing and ciari clones with full wash processing of 7.29 mm.

Sieve passing coffee

The percentage of coffee passing the Sieve showed differences in the diversity of robusta coffee clones and the postharvest method. The ciari coffee clone with full wash processing had the highest percentage of coffee that passed the Sieve and was the most different from the other clones at 50.42%, while the percentage that passed the smallest Sieve in the honey-processed srintil clone was 0.40% (Table 1).

Coffee bean defect value

The total quality defects of the robusta coffee bean local clone of West Lampung ranged from 2.55 to 12.90 in postharvest processing methods, both natural, honey, and full wash. Rope dale clones with the honey postharvest method had several quality defects that were not different from all rope dora clones with different postharvest methods, rona clones with the honey postharvest method, and srintil clones with honey and natural postharvest methods. The rope dale clones with the natural postharvest method had no different number of quality defects when compared to the ciari clones with the natural postharvest method and the tugu sari clones with the honey postharvest method, and several clones statistically did not have differences in the number of coffee bean defects (Table 1).

Discussion

Moisture content is a benchmark for obtaining good quality coffee beans, streamlining the roasting process time, and maintaining quality during storage. Coffee beans with more than 12.5% moisture content are more susceptible to fungal attacks during storage (Tolessa et al. 2017). The overall moisture content data meets the requirements of SNI 01-2907-2008, which is <12.5%. The moisture content of all treatments showed differences in the quality of green coffee beans. Figure 3 shows an analysis of local Robusta coffee clone variants on the influence of physical attributes with different postharvest methods.

This research observed a Difference in moisture content in each clone with different postharvest processing methods. A similar finding was also observed in the research done by Tassew et al. (2021). Moreover, drying processes, relative humidity (RH) of drying areas, coffee bean storage warehouses, and the level of physiological maturity of coffee beans could also affect the moisture content of coffee beans (Mintesnot et al. 2015). Observations on moisture content parameters using the oven method (one of the methods for calculating moisture content according to references) are thought to affect the resulting difference in moisture content. However, the oven's moisture content calculation has weaknesses, such as the loss of volatile compounds while heating the coffee bean sample and the evaporation of organic acids (Wicaksono et al. 2018). The weakness of using the oven is that the evaporation of volatile compounds is due to the high temperature that was being subjected to the sample while using the hot oven method to determine moisture content, that is 105°C, which, according to Sihombing et al. (2018), volatile compounds in coffee beans which were dominated by carboxylic compounds, would evaporate at temperatures of 80-90°C. Mendonça et al. (2007) reported that the moisture content using an oven based on ISO experienced higher water loss than the moisture content determination using the KFT (Karl Fischer Titration) method and infrared light.

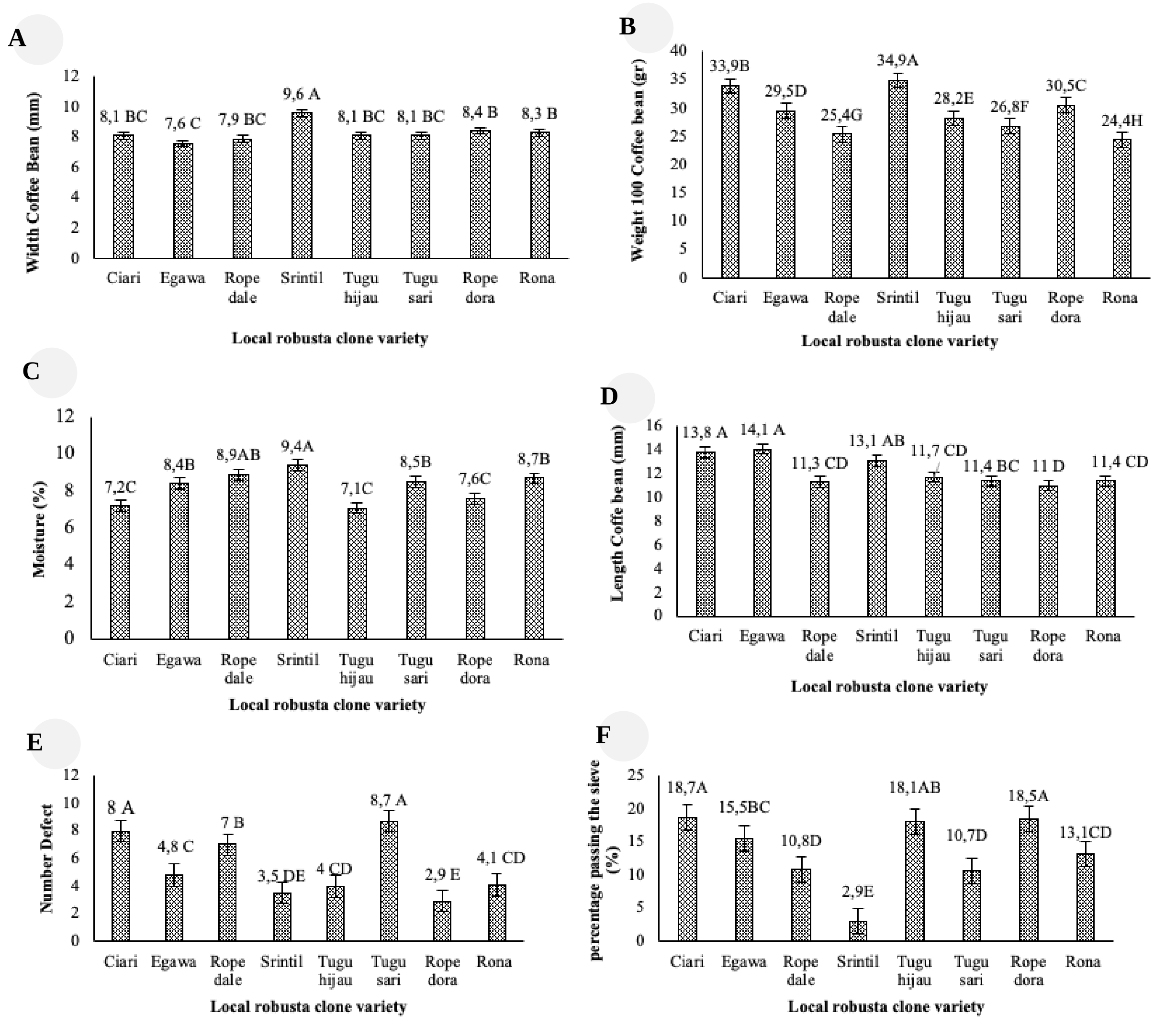

Figure 3. The characteristics of Robusta coffee clones. A. Moisture content (%). B. Weight 100 coffee beans (g). C. Length coffee bean (mm). D. Width) coffee bean (mm). E. Percentage passing the Sieve (%). F. The number of coffee bean quality defects. Values presented for each clones are the average from three different postharvest processing methods; in the column followed by the same letter, there is no significant difference; the HSD test is at the 5% level

In addition, the difference in moisture content from each treatment can be observed in Figure 3A. The srintil clone Robusta coffee beans had different moisture content in all robusta coffee clones except for the rope dale clone. Overall, the moisture content of each clone is different, and this is due to differences in the size of the coffee beans. Coffee beans from srintil clones have larger bean sizes, as shown visually in Table 1. Nevertheless, high moisture content can increase the dimensions of the coffee beans due to the increased bean volume caused by the filling of the pores of the beans with water (Khansa and Bintoro 2021).

Observation of the weight of 100 coffee beans showed a significant variation between different Robusta coffee clones and postharvest processing methods. The larger the size of the coffee beans, the heavier the weight of 100 coffee beans (Yusianto and Nugroho 2014). The research results on the weight of 100 coffee beans ranged from 22.00-39.30 g (Table 1). The weight of 100 robusta coffee beans has a considerable weight, and this is due to the selective harvesting process with optimal maturity of 95% (red-picked coffee). Coffee beans picked in the red stage have total amount of flavor-forming compounds compared to coffee beans picked at the yellow stage. Mulato (2018) stated that the maximum weight of the red-picking fruit is 4 kg/tree, while the yellow-picking coffee fruit is only 3 kg.

Based on Table 1, it can be seen that srintil clones with natural processes have a more significant weight; if related to the size of the coffee beans, srintil has a larger coffee bean size than other Robusta coffee bean clones. Likewise, the rona clone with the full wash process weighing 100 coffee beans has a smaller bean size compared to other robusta clones. The difference in weight of 100 coffee beans, observed by differences in robusta coffee clones, is caused by many metabolisms (physiology) of coffee fruit development under humidity, temperature, altitude, and soil moisture (Mintesnot et al. 2015). Meanwhile, observed by the postharvest method, coffee beans processed naturally have a lot of substrate with a complex chemical composition because it has many pulp (flesh) and mucilaginous ingredients (Nugroho et al. 2016; Mulato 2019); this could be affected the weight of 100 coffee beans. Harvesting arabica coffee beans produced in Hararghe, East Ethiopia, with different harvesting methods weights 100 coffee beans greater than selective harvesting (red picking pods) compared to strip harvesting (harvesting of red and partly red coffee cherries) on the processing method wet postharvest (full wash) than dry postharvest (Mohammedsani et al. 2017) Figure 3B shows the effect of local robusta coffee clones on the weight of 100 coffee beans (g). Overall, eight local robusta coffee clones make a difference in the weight of 100 coffee beans (g). Differences in coffee cultivars significantly affect the weight of 100 coffee beans based on processing methods and characteristics of coffee cherries (Sualeh and Dawid 2014).

The size of the coffee bean becomes a physical quality standard for exporters and importers, which is related to price determination (Leroy et al. 2006); large coffee beans have a higher price trend. The West Lampung robusta coffee clone has smaller length and width than the robusta coffee clone from Tanggamus Lampung (Ramadiana et al. 2018). However, Ramadiana et al. (2021) reported that robusta coffee clones cultivated by local Lampung farmers have a similar genetic base with a similarity level of 68.4%. The effect of different postharvest processing methods on the local coffee beans' length and width are presented in Figure 3C, D).

Figure 3C shows that the longer coffee bean length is the ciari and egawa clones than the other clones (rope dale, tugu hijau, tugu sari, rope dora, and rona clones). The srintil clone has the same coffee bean length as ciari and egawa. Figure 3D shows that the srintil clone has the widest coffee width compared to other robusta coffee clones. Differences in size (width and length) of coffee beans are caused by wide morphological variations in the characteristics of robusta coffee genotypes (Wale Mengistu et al. 2020), differences in shade and sunlight reception (Vaast et al. 2006), tree age factors, agricultural management in management. Cultivation, such as maintaining old plants, also affects the size of coffee beans (Ngugi and Aluka 2019). Apart from that, the difference in the length and width of the coffee beans is thought to be because Robusta coffee cherries have clustered fruit types, so the fruit size is not the same as one another in receiving nutrients (Figure 4).

Based on field observations, the size of robusta coffee cherries consists of three, namely large, medium, and small, in one bunch, different sizes of coffee beans. Furthermore, the differences in coffee cultivars and genotypes produce different sizes of coffee beans. However, Wintgens (2004) stated that differences in bean size are not only due to genetic factors but also caused by environmental conditions and the use of organic matter in cultivation practices.

Coffee passing through the Sieve is a way to get uniform-size coffee beans, which is one of the essential requirements of foreign consumers. Based on SNI 01-2907-2008, the separation of robusta coffee beans using a sieve is differentiated based on the postharvest processing method, namely the dry postharvest processing method (natural and honey) consisting of two Sieve, that is the first hole sieve 6.5 mm (sieve no. 16) and the second hole sieve is 3.5 mm (sieve no. 9). While the wet postharvest processing (full wash) comprises three levels, the top sieve arrangement is 7.5 mm (sieve no 19), followed by the middle sieve hole, 6.5 mm (sieve no 16), and the sieve hole, 5.5 mm (sieve no 14) (Mulato 2018) (Badan Standarisasi Nasional 2008). Table 1 shows the passing rate of the dry processing sieve (Honey) in the Srintil clone of 0.4%, meaning that 99.6% of the seeds retained in the first Sieve have a diameter greater than 6.5 mm (sieve no. 16). Based on Badan Standarisasi Nasional (2008) the calculation of the Analysis of srintil clone coffee beans in honey processing (0.4%) is smaller than the maximum % mass fraction requirement (5%) so that it is categorized as large size (L). Whereas in wet processing (full wash), the value of coffee passing the ciari clone sieve was 50.42%, meaning that 49.58% of the coffee was retained in the first Sieve, which had a larger diameter of 7.5 mm (sieve no.19). The value of passing through the Ciari clone sieve in full wash processing was greater (50.42%) than the maximum % mass fraction requirement (5%) so that it was categorized as medium seed size (M). Based on the content of coffee passing the Sieve (%) (Table 1), coffee beans from local robusta coffee clones with dry (natural, honey) and wet (full wash) postharvest processing methods are grouped into two criteria for large (L) and medium bean sizes (M) (Table 2).

Based on the results of the sieve pass count in Table 2, it shows that of eight clones with three postharvest processing medium-sized robusta coffee beans, and only natural and honey processed ciari clones, honey and natural processed srintil clones with categories coffee bean size large (L). Classifying coffee beans is based on the size required by the Indonesian National Standard regarding coffee beans, avoiding coffee bean defects, and foreign objects included in the beans must be removed (Widyotomo and Mulato 2005). It could absorb heat better and cook homogeneously (Torrez et al. 2023). In addition, the large and uniform seed sizes produce a uniform roasting result quality that correlates with taste (Subedi 2010; Alemnew and Kebede 2020). The use of passing sieve criteria aims to make it easier to determine the sample size (large, medium, or small). For coffee bean-sized farmers, it also provides a higher price incentive for large beans than small-sized coffee (Setyani et al. 2018; Randriani et al. 2014).

The results of the Analysis of variance based on local robusta coffee clones to see the effect of physical attributes passing the coffee bean sieve can be observed in Figure 3E. Figure 3E shows that the srintil robusta coffee clone differs from all clones based on the percentage of coffee passing the Sieve. In the Srintil clone, the coffee passed through the Sieve was 2.7%, meaning that 97.3% of the beans retained on the first Sieve had a diameter greater than 6.5 mm. Based on these calculations, the srintil coffee is larger than the other clones. The coffee bean size criterion influences coffee's price and is essential in producing good-tasting roasted coffee. Consumers believe that large bean size positively correlates with quality, but in reality, large bean size does not always provide a better taste than small bean size (Wintgens 2004).

The total value of quality defects is classified based on the quality of the SCAA system, which is divided into two criteria, namely the fine robusta (specialty) and the premium criteria. The fine robusta (specialty) criterion indicates that the maximum number of defects is five, and the premium criteria are 8. Based on the SCAA criteria, the eight robust coffee clones can be classified as fine and premium coffee beans (Figure 3F).

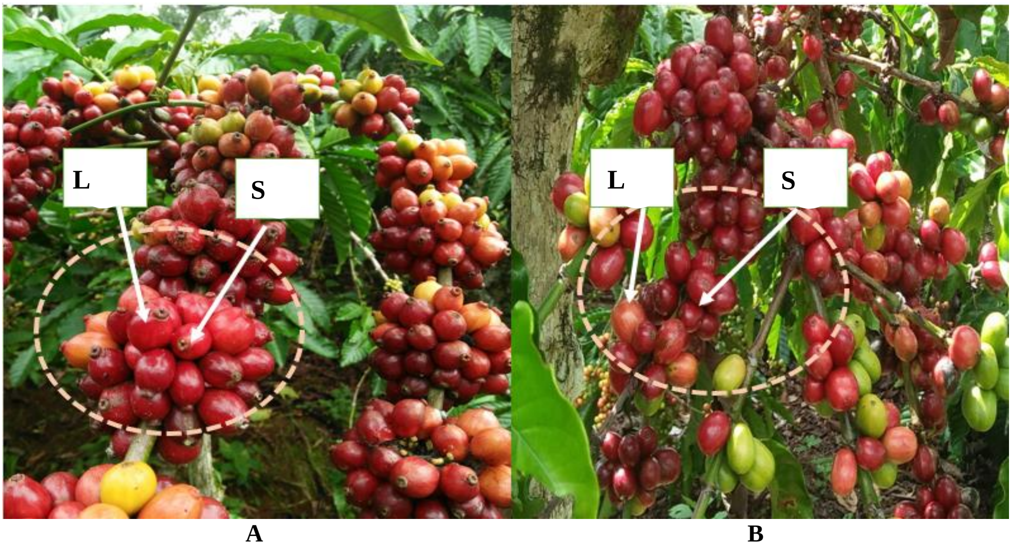

Figure 4. Visualization of a red robusta coffee cherries. A. Clone Egawa. B. Clone Srintil. L: large, S: small

Table 2. Coffee bean size criteria for eight Robusta coffee clones using the postharvest method (natural, honey, and full wash) based on pass the Sieve (screen analysis)

Process	Clone							
	Ciari	Egawa	Rope dale	Srintil	Tugu hijau	Tugu sari	Rope dora	Rona
	Passed sieve (%)							
Natural	2.75 (L)	6.40 (M)	12.3 (M)	0.77 (L)	7.82 (M)	6.85 (M)	5.42 (M)	8.67 (M)
Honey	3.05 (L)	8.28 (M)	9.76 (M)	0.40 (L)	7.07 (M)	8.85 (M)	7.75 (M)	9.12 (M)
Full Washed	50.42 (M)	31.87 (M)	10.47 (M)	7.52 (M)	7.07 (M)	16.27 (M)	42.20 (M)	21.45 (M)

Note: L: Large, M: Medium

The effect of the robusta coffee clone variant on the number of coffee defects in coffee clone differences between ciari clones was no different from the tugu sari clones but different from other coffee clones (egawa, rope dale, srintil, tugu hijau, rope dora, and rona). The number of defect values from Figure 3F is more than 5, indicating that the ciari, tugu sari, and rope dale clones are included in the premium grade criteria. In contrast, the egawa, srintil, tugu hijau, rope dora, and rona coffee clones are the criteria for specialty (fine). Analianasari et al. (2022) reported that the type of West Lampung robusta coffee bean is included in the premium coffee type with grades 1-2, and this grade is more desirable as a commercial coffee bean. Increasing the quality of coffee bean grades from premium to fine (specialty) based on the type of quality defects shows that farmers improve the sanitation of coffee cultivation land to minimize damage caused by coffee berry borer (PBKo) pests.

In conclusion, based on the quality of the physical attributes produced, all clones can produce premium-quality coffee beans. Still, the srintil coffee clones in drying processing (natural and honey) provide the best quality physical attributes. The findings from this study were that the diversity of local cloned robusta coffee with various postharvest methods provides information that local genetic diversity indicators provide different physical attributes. Still, more significant and repeated experiments are needed to obtain the results accurately.

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