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Morphology identification and description of coffee plants (*Coffea sp*) in Karo District

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Abstract. Coffee is individual of the other plantation supplies that has a great commercial worth amid other estate harvests and plays a significant role as a basis of external exchange. This research aims to identify and determine the morphological characters of coffee plants (*Coffea sp*) in the three Sub-Districts Merek, Naman Teran, and Simpang Empat, Districts of Tanah Karo, North Sumatera, Indonesia. The research was conducted in 2019 which consisted of 27 plant samples. This research is an exploratory research which is conducted by survey and the sample is taken by using accidental sampling method. Observation of coffee morphological characters based on the IPGRI (International Plant Genetic Resources Institute) descriptor manual. The results showed that 27 coffee accessions found in each location had a relatively close similarity distance with the farthest kinship value of 8.813 found in the K₂₆ and K₈ accessions.

1. Introduction

Coffee is single of the other plantation produces that has a great economic value between other plantation yields [1]. The greatest of the coffee assembly in North Sumatra is formed by trivial owner plantations. Arabica coffee production reached 48,354.26 tons per year, while Robusta coffee was 8,393.18 tons per year [2]. The main producers of Arabica coffee in North Sumatra, are the districts of Dairi, North Tapanuli, Simalungun, Karo and Humbang Hasundutan. Arabica coffee is a leading commodity in North Sumatra [3].

The advantages of a type of coffee can be seen from the high production, taste and aroma of the coffee produced. Factors that influence the superiority of quality and quantity of coffee plants depend on the height of the growing area, climate, category of coffee grown, cultivation techniques used, yield processing, and post harvest. Arabica coffee is suitable for establishing in highland areas, while Robusta coffee is suitable for planting in lowland areas [4].

Districts of Karo is one of the coffee-producing centers in North Sumatra. According to [5], The area Districts of Karo in 2015 was 7,595 ha with a total production of 5,785.86 tons, in 2016 it was 7,741 ha with a total production of 7,485.85 tons, in 2017 it was 8,378 ha with a total assembly of 8,777.02 tons. Districts of Karo consists of 17 Sub-Districts, of which Merek, Naman Teran and Simpang Empat Sub-Districts have rather great production values and coffee areas. In 2017, Merek Sub-District with an area of 966 ha had a total production of 101 tons, Naman Teran Sub-District with an area of 427 ha had a total production of 207 tons, and Simpang Empat District with an area of 1,021 ha had a total production of 355 tons.



2. Materials and methods

This research was conducted in Simpang Empat, Naman Teran, and Merek Sub-Districts, of Karo District, North Sumatra. The materials used in this study were several coffee plants by taking plant samples from three of Sub-Districts.

This research is an investigative research directed with a review method, namely identifying the morphological characteristics of coffee plants in District of Karo. In this study, 27 plant samples were taken in three the Sub-Districts with accession codes K₁, K₂, K₃, K₄, K₅, K₆, K₇, K₈, K₉, K₁₀, K₁₁, K₁₂, K₁₃, K₁₄, K₁₅, K₁₆, K₁₇, K₁₈, K₁₉, K₂₀, K₂₁, K₂₂, K₂₃, K₂₄, K₂₅, K₂₆, and K₂₇.

Data observation was carried out through the morphological characters of coffee plants both qualitatively and quantitatively based on the coffee descriptor manual [6]. Observation of morphological characters based on the IPGRI guidebook consists of:

- 1) Stem morphology: general presence, plant height, plant standing, stipule expansion.
- 2) Leaf morphology: leaf figure, leaf angle figure, leaf span, leaf size, leaf casket measurement, leaf casket color, early leaf color, grown leaf color, venation outline, color of shoot rotations.
- 3) Flower morphology: position of flowering, flowering of old stems, numeral of Axil-1 flowers, numeral of fascicle-1 flowers.
- 4) Ovary morphology: fruit color, fruit form, endocarp surface, fruit dimension, fruit size, fruit width, pulp thickness.
- 5) Seed morphology: seed figure, seed color, seed dimension, seed size, seed width, fresh and dry weight of 100 seeds.

3. Results and discussion

3.1. Morphological character

In general the data Analysis of Research Sites and Plant Conditions can be seen in Table 1. Also there were showed the coffee identification location in Karo Regency based on the accession code at each location:

The results showed that out of the 27 coffee samples, there is only 1 type of coffee in the sub-districts of Merek, Naman Teran and Simpang Empat, namely arabica coffee. Based on the observations of the morphological characters of coffee plants in Karo Regency, it showed that there was a diversity in the overall morphological characteristics of the appearance, plant characteristics, leaf shape, fruit color, fruit shape, seed color, and bean shape. However, the observation of leaf petiole color, young leaf color, mature leaf color, venation pattern, flowering position, old stem flowering, amount of Axil-1 flowers, numeral of fascicle-1 flowers, endocarp texture, fruit thickness, and pulp thickness have similarities characteristics of the 27 coffee accessions identified.

Based on interpretations of the overall appearance parameters, there were 3 variations of the 27 coffee accessions identified, that is the shape of the bush, cone and pyramid (figure 1), however in plant leveling parameters, there were 2 variations found, namely shrubs and small trees which were determined from the height of the coffee plant.

In general, the identification results of leaf morphological characters showed that there were 4 leaf shapes found, namely ellipse, ovule, round and lanceolate (figure 2). In general, coffee leaves are slightly rounded, the shape of the leaf base is tapered, wavy and looked shiny and the color of the leaves is green in accessions K₂, K₄, K₅, K₆, K₇, K₁₃, K₁₄, K₁₅, K₁₆, K₂₁, K₂₃, K₂₄, K₂₅, and K₂₇. According with the literature [7] which states that the coffee leaves have an ovoid shape, sideways, wavy, dark green, stocky, and tapered at the edges. Arabica coffee has smaller and thinner leaves when compared to the Robusta coffee species which has wider and thicker leaves. Arabica coffee leaves are dark green in color, while Robusta coffee is light green.

Table 1. General data analysis of research sites and plant conditions.

Sub-District	Village	Genotype Code	Altitude (m)	Varieties	Plant Age (Years)	Method of Propagation
Merek	Ergaji	K1	1277	Arabica	7	Cutting
		K2	1264	Arabica	10	Seed
		K3	1248	Arabica	3	Cutting
	Dokan	K4	1280	Arabica	5	Cutting
		K5	1283	Arabica	9	Cutting
		K6	1282	Arabica	7	Cutting
		K7	1302	Arabica	11	Seed
	Mulia Rakyat	K8	1291	Arabica	7	Cutting
		K9	1296	Arabica	7	Cutting
		K10	1320	Arabica	5	Cutting
Naman Teran	Sukandebi	K11	1280	Arabica	6	Cutting
		K12	1324	Arabica	4	Cutting
		K13	1351	Arabica	6	Cutting
	Naman	K14	1359	Arabica	4	Cutting
		K15	1311	Arabica	10	Seed
		K16	1334	Arabica	6	Cutting
	Kuta Rakyat	K17	1359	Arabica	8	Cutting
		K18	1350	Arabica	8	Cutting
		K19	1220	Arabica	3	Cutting
	Simpang Empat	Lingga	K20	1224	Arabica	5
K21			1217	Arabica	7	Cutting
K22			1226	Arabica	6	Seed
Lingga Julu		K23	1221	Arabica	6	Seed
		K24	1212	Arabica	5	Cutting
		K25	1250	Arabica	6	Cutting
Ndokum Siroga		K26	1288	Arabica	7	Cutting
		K27	1287	Arabica	10	Cutting

**Figure 1.** Generally appearance of coffee plants in district of karo (a) cone, (b) bushy, (c) pyramid.

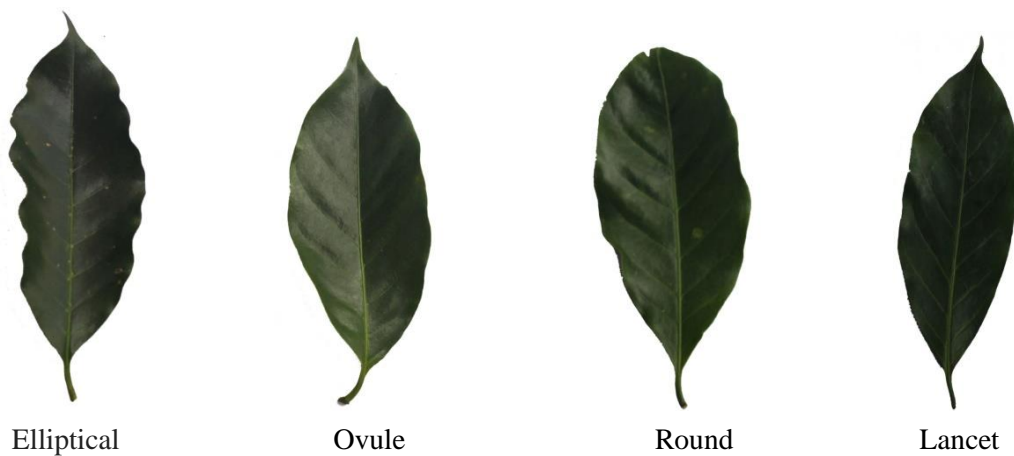


Figure 2. Foliage shape of coffee plants in District of Karo.

The morphological character of the fruit showed that there were 4 fruit shapes found, namely round, slightly round, elliptical, and oblong (figure 3). In general, the shape of the coffee fruit is slightly rounded with red ripe fruit colors found in accessions K₂, K₃, K₅, K₆, K₇, K₁₀, K₁₂, K₁₄, K₁₈, K₁₉, and K₂₅. This is consistent with the literature [8] which states that the raw coffee cherries are light green. Suitable coffee ovary red or dark red. The length of the Arabica coffee cherries is about 12-18 mm. Meanwhile, robusta coffee is 8-16 mm.

Based on observations of the morphological characters of the seeds, there were 3 variations in the shape of the seeds, namely slightly rounded, elliptical and oblong. In general, the shape of coffee beans was slightly ovoid or elliptical and has a yellow color in accessions K₁, K₂, K₃, K₄, K₅, K₆, K₇, K₉, K₁₀, K₁₁, K₁₂, K₁₃, K₁₄, K₁₆, K₁₉, K₂₀, K₂₂, K₂₃, K₂₅, K₂₆ and K₂₇. Coffee beans consist of a bean shell and an institution and have a tough texture.



Figure 3. Ovary shape of coffee plants in District of Karo.

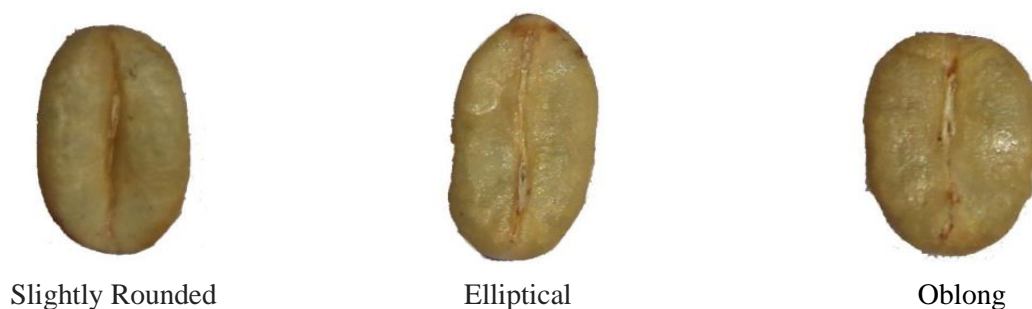


Figure 4. Shape of coffee beans in District of Karo.

3.2. *Khinship relations*

It is identified that among the 27 accessions the contiguous kinship is found in the K₉ and K₁₀ accessions with a measurement expanse value of 0.789 with 1 appeal variance from the 19 appeals observed, namely the character of the fruit, while the furthest kinship relationship is found in between the K₂₆ and K₈ accessions with the measurement distance value 8.813 with 9 different characters from 19 characters detected, specifically leaf tip form, leaf figure, young leaf color, fruit character, fruit ribs, calyx firmness, endocarp surface, pulp width and seed color.

Table 2. The relationship between 27 coffee accessions in District of Karo from the dissimilarity matrix.

No	Khinship Relations		Coefficient Vallue
1	K10	K9	0.759
2	K10	K3	2.248
3	K20	K14	2.294
4	K9	K3	2.373
5	K19	K10	2.657
6	K19	K9	2.763
7	K27	K23	2.809
...			
54	K8	K6	8.100
55	K22	K8	8.109
56	K8	K2	8.200
57	K18	K8	8.282
58	K16	K8	8.643
59	K17	K8	8.790
60	K26	K8	8.813

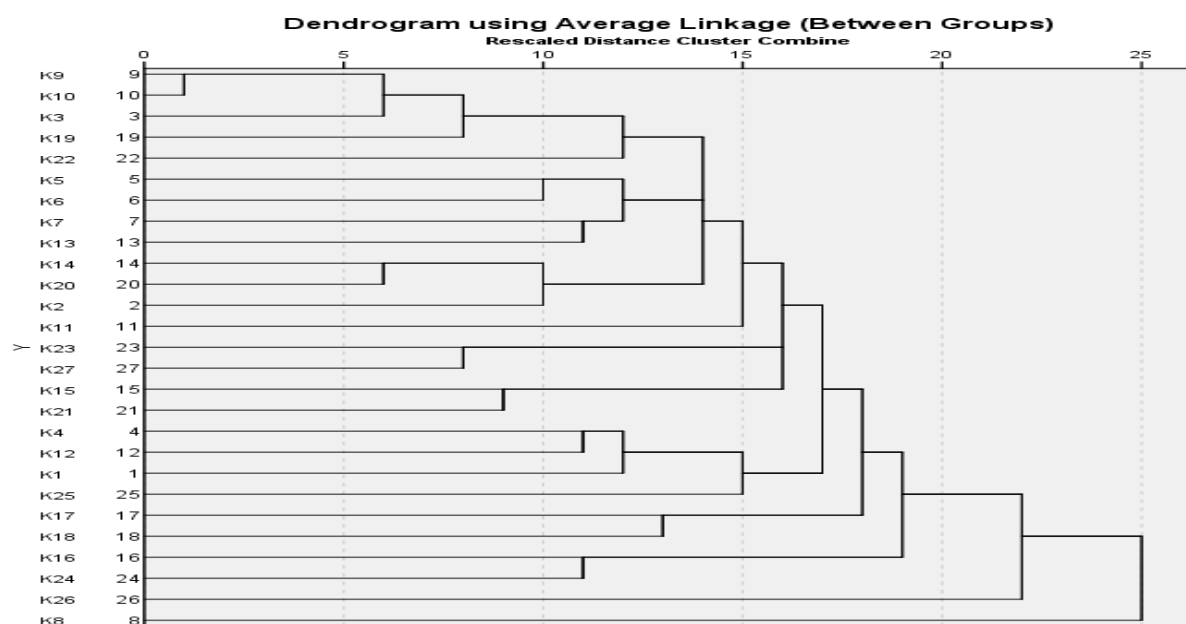


Figure 5. Dendrogram of coffee kinship in District of Karo.

The level of similarity between the 27 coffee accessions identified in Karo District showed a relatively close coefficient value. This is in agreement with the literature [9] which conditions that the similarity expanse is said to be distant if it is less than 0.6 or 60% so that the grouping of the 27 coffee accessions identified has little kinship.

Based on the morphological characters of 27 coffee accessions, the value of kinship obtained, can be seen in the table 2.

Based on the dendrogram formed, scale of 25 (figure 5), there were 3 kinship groups. Group I only consisted of K₈ accession which had a different character, namely the color of the beans which were colored brown and purple. The second group (II) only consists of K₂₆ accessions which have special characters, namely having a slightly rounded leaf shape and a rounded leaf tip and other accessions are included in the third group (III).

The qualitative based kinship analysis on a scale of 19 showed that there were 4 groups, namely the first group (I) only contains of K₈ accession. The second group (II) only contains of K₂₆ accession. The third group (III) contains of 2 accessions, namely K₂₄ and K₁₆ which have different distinct characters, namely the overall shape, the stipule shape, the leaf tip shape, and the seed shape. The fourth group (IV) consisted of another 23 accessions.

4. Conclusions

Established on the dendrogram formed, there were three clusters of kinship on the measure of kinship distance (Euclidean expanse) 19, 22, and 25, with the farthest kinship obtained in K₂₆ and K₈, namely 8,813. The identification results of the coffee morphological characters in the K₈ accession were separated from additional groups because they had special characteristics, namely purplish brown bean color. The results of the research on the identification of coffee morphological characters in District of Karo showed that the 27 coffee accessions found in each location had relatively close similarities.

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