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Characterization of leaf morphology on several rambutan (*Nephelium lappaceum*) cultivars from Serang City, Banten, Indonesia

Karakterisasi morfologi daun pada beberapa kultivar rambutan (*Nephelium lappaceum*) dari Kota Serang, Banten, Indonesia

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Abstract. *Windarsih G. 2022. Characterization of leaf morphology on several rambutan* (Nephelium lappaceum) *cultivars from Serang City, Banten, Indonesia. Pros Sem Nas Masy Biodiv Indon 8: 18-23.* Rambutan (*Nephelium lappaceum* L.) is of tropical fruit with an extensive distribution. In Indonesia, rambutan has many cultivars and wild relatives, which spread in many regions, including Sumatra, Java, and Kalimantan. As rambutan begins to produce fruits for the first time in 3-4 years and then has fruits once a year, the leaf characters need to be observed to obtain specific markers to be used to distinguish among rambutan cultivars in a vegetative phase. The purpose of the study was to characterize several rambutan cultivars from Serang City, Banten, based on leaf morphological characteristics. Seven plants of five rambutan cultivars in the area of Serang City, Banten, were collected to observe leaf morphological characteristics. Based on the results, all rambutan cultivars observed had variations in the number of leaflets per leaf, rachis length, length of petiole, leaflet length, leaflet width, leaflet shape, and leaflet apex. Therefore, the leaflet length, leaflet width and petiole length could be used as informative characters to distinguish Rapiah from other cultivars.

Keywords: Leaf morphology, *Nephelium lappaceum*, rambutan

Abstrak. *Windarsih G. 2022. Karakterisasi morfologi daun pada beberapa kultivar rambutan* (Nephelium lappaceum) *dari Kota Serang, Banten, Indonesia. Pros Sem Nas Masy Biodiv Indon 8: 18-23.* Rambutan (*Nephelium lappaceum* L.) merupakan salah satu tanaman buah tropis dengan distribusi yang luas. Di Indonesia, rambutan memiliki banyak kultivar beserta kerabat liarnya yang tersebar di berbagai wilayah, diantaranya Sumatera, Jawa, dan Kalimantan. Oleh karena rambutan mulai menghasilkan buah pertama kali pada umur 3-4 tahun dan menghasilan buah setahun sekali, pengamatan terhadap karakter daun diperlukan sehingga diperoleh penanda spesifik yang digunakan untuk membedakan di antara kultivar rambutan pada fase vegetatif. Tujuan dari penelitian ini adalah untuk mengkarakterisasi berbagai kultivar rambutan di kawasan Kota Serang, Banten berdasarkan karakter morfologi daun. Tujuh tanaman dari lima kultivar rambutan yang diambil dari wilayah Kota Serang, Banten dikoleksi untuk dilakukan pengamatan karakter morfologi daun. Berdasarkan hasil yang diperoleh, semua kultivar rambutan yang diamati menunjukkan adanya variasi dalam jumlah anak daun, panjang ibu tangkai daun, panjang tangkai anak daun, panjang helaian anak daun, lebar helaian anak daun, bentuk helaian anak daun, dan ujung anak daun. Panjang helaian anak daun, lebar helaian anak daun, dan panjang tangkai anak daun dapat digunakan sebagai karakter yang informatif untuk membantu membedakan Rapiah dari keempat kultivar yang lain yang diamati.

Kata kunci: Morfologi daun, *Nephelium lappaceum*, rambutan

INTRODUCTION

Rambutan (*Nephelium lappaceum* L.) is one of tropical fruit with a large distribution. It belongs to Sapindaceae family which expected to originate from South East Asia, especially Indonesia and Malaysia. In Indonesia, rambutan has many cultivars and its wild relatives which spread in many regions, included in Sumatra, Java and Kalimantan (Leenhouts 1986; Siebert 1991). Siebert (1991) reported that there were 22 species of *Nephelium* in the world, 16 of them were found in Kalimantan. Meanwhile based on the last study conducted by Uji (2004), there were eight species of *Nephelium* found in Kalimantan, so that Kalimantan is still considered as the center of diversity of *Nephelium*. Rambutan commonly grow well at 30-500 m asl with annual rainfall ranges between 1500-2500 mm (Lestari et al. 2013).

Almost all parts of rambutan have many benefits. The fruit can be consumed as fresh fruit or other processed products, such as canned fruit, jelly or jam (Sirisompong et al. 2011). The fruit flesh, known as aryl, is potential as stomachic and anthelmintic, and to against diarrhea and dysentery (Suganthi and Josephine 2016). The fruit rind is potential as antibacterial (Fidrianny et al. 2015), antioxidant, anti-hyperglycemic agent (Palanisamy et al. 2011), antidiabetic, anti-hypercholesterolemic (Muhtadi et al. 2016), and manufacture of soap (Suganthi and Josephine 2016). The seeds is potential as antioxidant, anti-

hyperglycemic agents (Palanisamy et al. 2011), anti-hypertension (Singh et al. 2017), and manufacture of candle and soap (Suganthi and Josephine 2016). The leaf can be used as coloring agent and the medicinal properties to treat headache (Suganthi and Josephine 2016). Meanwhile, the trunk is used as materials of construction and firewood (Middleton 2000), the bark is used to treat thrush, and the root is used as a febrifuge (Suganthi and Josephine 2016).

Rambutan is cross-pollinated plant so that it has a high genetic variation among its progeny (Tindall et al. 1994). There are many cultivars of rambutan found in Indonesia, such as Rapiah, Sinyonya, and Aceh. Each rambutan cultivar has specifically fruit characters, starting from fruit rind color, fruit shape, fruit thickness, texture of fruit spine, spine density, spine color, spine strength, aril colour, aril thickness, aril texture, up to aril taste (IPGRI 2003; Kuswandi et al. 2014). Thus, the morphological characters can be used to measure the diversity in plant based on the phenotype, both in vegetative and generative phases (Stoskopf et al. 2019). Subsequently, flower and fruit's morphological characters in several rambutan cultivars had been characterized, as follows by Kuswandi et al. (2014) and Windarsih and Efendi (2019). However, rambutan begins to produce fruits for the first time in 3-4 years and then produce fruits once year. So that, another characters are required to be used to differentiate among cultivars where they are available at all times (Manggabarani et al. 2018).

The rambutan leaf is ovate-shaped, entire edge, scattered, the tip and base leaf blade are acuminate, pinnate, green with cylindrical petiole, and the leaf blade size ranges between 10-20 cm length and 5-10 cm width (Lestari et al. 2013). The leaf of rambutan is highly varied so that it is potential to be used as marker in differentiating among cultivars. It is useful to make the characterization of cultivars in a short period. The specific character of rambutan leaf used as a specific marker to differ from each other cultivars has not been obtained (Barreto et al. 2015). Therefore, the leaf characters need to be observed to obtain specific marker(s) to be used to distinguish among rambutan cultivars.

The molecular character is actually powerful to be used in identifying genotype characters in plant, but it is too expensive to be applied. Meanwhile, the observation of leaf morphological character can be conducted all the time and the cost required is not too expensive. Besides that, the information of specific character on leaf of rambutan also will be useful for plant cultivator to differentiate rambutan cultivars in a nursery phase. A study of leaf morphological characteristics of rambutan in Serang City can become one of the databases as additional information on the diversity of rambutan from Banten Province region. The purpose of the study was to characterize several rambutan cultivars from Serang City area based on the leaf morphological characters.

MATERIALS AND METHODS

Sample collection

The rambutan plants used in this study were collected from the area of Serang City, Banten province, Indonesia (Figure 1). There were seven plants collected from 5 cultivars, i.e. Rapiah (1 plant), Aceh (2 plants), Sinyonya (1 plant), wild type (2 plants), and male tree (1 plant), for identifying the leaves morphological characteristics. The plants used had already produced flowers and fruits.

Observation of leaf morphology

The research was conducted using an exploratory method by tracing the existence of plants in the research area (Najira et al. 2020). The leaves were collected as many as 10 leaves per each plant. The observation of leaf morphological characters was conducted according to the Descriptor of Rambutan (IPGRI 2003) and Tjitrosoepomo (2003). The first pair of leaflets from terminal leaflet on each leaf which the predominant one were used as the samples (IPGRI 2003). The leaf characters observed included in 14 characters, consists of the number of leaflets per leaf, rachis length [from stem to last leaflet], length of petiole or leaflet stalk [from the rachis to the base of leaflet], leaflet length [from the base to the tip of leaflet], leaflet width [measured at the widest point], leaflet shape, leaflet color [light green, green, dark green], leaflet apex shape, leaflet base shape, leaflet margin [entire, undulate, involute, curled], leaflet surface [smooth, pubescent] (IPGRI 2003), arrangement of leaflets on rachis, leaflet venation, and leaflet intervenium (Tjitrosoepomo 2003). The leaflet apex was determined according to a quarter part from leaflet tip, while leaflet base was determined according to a quarter part from leaflet base.

Data analysis

The qualitative data obtained were analyzed descriptively by comparing the leaf morphological characters among cultivars. Meanwhile, the quantitative data, i.e. rachis length, length of petiole, leaflet length and leaflet width, were analyzed using SPSS version 15.0. The mean defference among each cultivar observed was determined using Duncan's test at a 5% confidence level. Furthermore, the data of leaf morphological characters were converted into binary data, and then analyzed using UPGMA (Unweighted Pair Group Method with Arithmetic Means) through the NTSYs Program version 2.02 (Rohlf 1998).

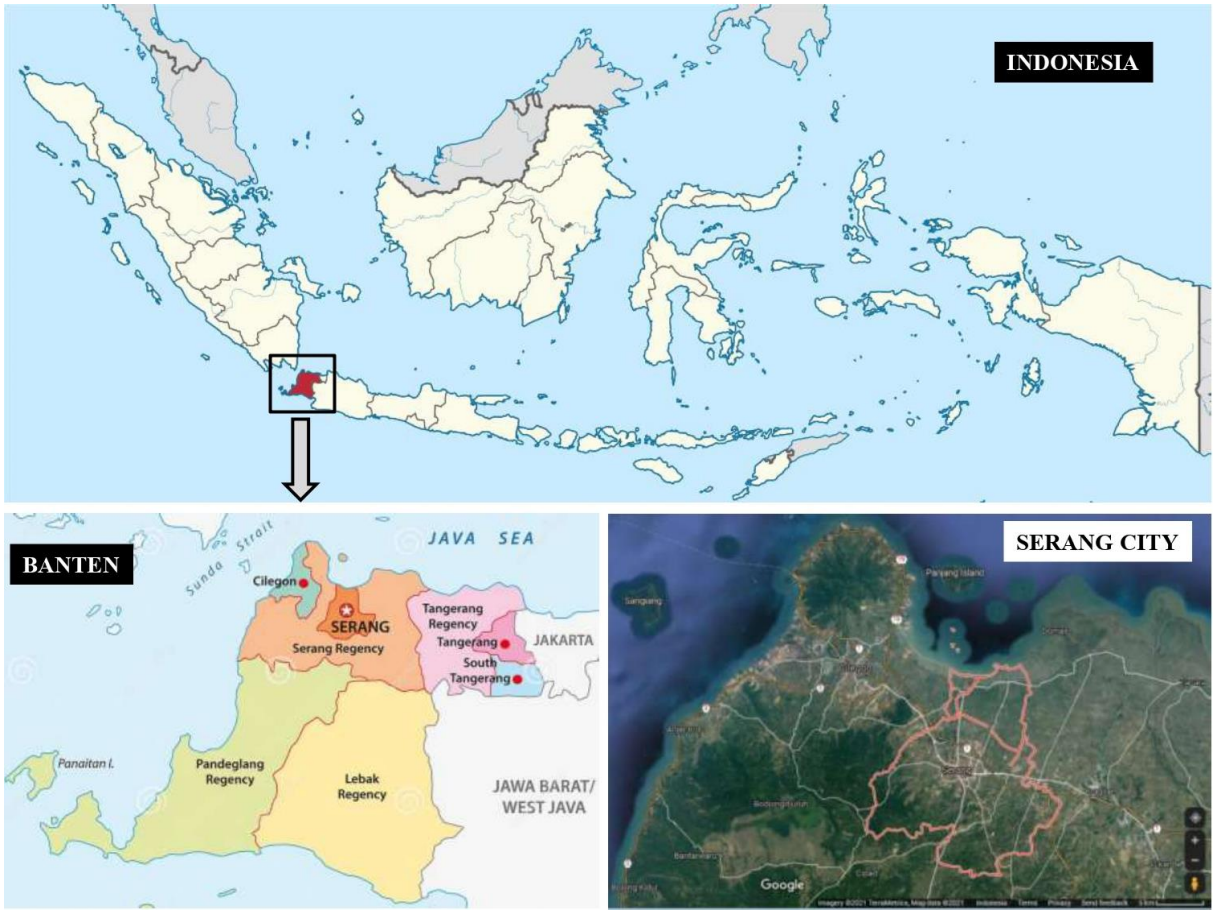

Figure 1. Location of the rambutan leaf collection in Serang city region, Banten

RESULTS AND DISCUSSION

Based on the result of exploration, there were five cultivars collected from Serang city region, Banten, i.e. Aceh, Rapiah, Sinyonya, Wild Type and male tree. The five cultivars were observed for the morphological characteristics, including number of leaflets per leaf, length of rachis, length of petiole, length of leaflet, leaflet width, leaflet shape, leaflet colour, leaflet apex, leaflet base, leaflet margin, leaflet surface, arrangement of leaflets on rachis, leaflet venation and intervenium (Table 1).

Based on the observation result of qualitative data (Table 1), an arrangement of leaflets on rachis in all cultivars observed is abruptly pinnate. The leaf of rambutan cultivars contained 1-10 leaflets. Meanwhile, the morphological characters of leaflet in five cultivars commonly are as follows: the color of leaflet is dark green, the margin of leaflet is entire, the leaf base is acute, the leaflet surface is smooth, the leaflet venation is penninervis, and the intervenium of leaflet blade is parchment-like. This result is according to Najira et al. (2020) reported that rambutan leaf found in Aceh province is dark green, however the rambutan leaf has a variation of leaf margin (entire, undulate).

Rambutan cultivars observed were varied in some morphological characters, i.e. leaflet shape, number of leaflets per leaf, rachis length, length of petiole, length of leaflet, leaflet width, and leaflet apex shape (Table 1). The shape of leaflet in all cultivars is elliptical, elliptical-oblong, or obovate (Figure 2), while the leaflet apex is acute, retuse or acuminate (Figure 3). The variation of leaf morphology in several accession of rambutan was also obtained by Kuswandi et al. (2014) showed that the leaflet shape commonly was elliptical or obovate, the leaflet apex was obtuse, and the leaflet base was acute. Meanwhile Najira et al. (2020) reported the variations of leaflet shape (elliptical, ovate, obovate) and leaflet tip (acute, acuminate, rounded) of rambutan plants from Aceh province region.

Meanwhile, based on the ANOVA result, the rachis length was not significant different (sig. 0.299) on all cultivars observed (Table 2). The highest length of rachis was obtained from wild type (20.08±2.62 cm), while the lowest was Rapiah (15.37±4.35 cm) (Table 1). The length of rachis in Aceh cultivar ranged from 9.2-23.9 cm, Rapiah 10.6-22.3 cm, Sinyonya 10.8-26.7 cm, wild type 16.7-24.5 cm, and male tree 10.3-33.4 cm.

Table 1. The morphological characters observed on the first pair of leaflets in terminal leaflet among six rambutan cutivars

No	Leaf characters	Rambutan cultivars				
		Aceh	**Rapiah**	**Sinyonya**	**Wild Type**	**Male Tree**
1	Number of leaflets per leaf	2-9	1-10	2-7	2-8	2-10
2	Length of rachis (cm)	16.93±4.44	15.37±4.35	16.17±5.03	20.08±2.62	18.74±6.76
3	Length of petiole (mm)	6.44±1.05	5.36±0.47	7.00±0.89	7.13±0.51	7.27±1.42
4	Leaflet length (cm)	16.40±2.16	14.06±1.49	17.31±1.95	18.35±2.45	18.72±1.71
5	Leaflet width (cm)	8.09±1.12	6.28±0.55	8.43±1.00	8.04±1.10	8.52±0.95
6	Leaflet shape	elliptical, elliptical-oblong, obovate	elliptical, elliptical-oblong, obovate	elliptical, elliptical-oblong, obovate	elliptical, elliptical-oblong	elliptical, elliptical-oblong, obovate
7	Leaflet colour	dark green	dark green	dark green	dark green	dark green
8	Leaflet apex	acute, retuse, acuminate	acute, retuse, acuminate	acute, acuminate	acute, retuse	acute, retuse, acuminate
9	Leaflet base	acute	acute	acute	acute	acute
10	Leaflet margin	entire	entire	entire	entire	entire
11	Leaflet surface	smooth	smooth	smooth	smooth	smooth
12	Arrangement of leaflets on rachis	abruptly pinnate	abruptly pinnate	abruptly pinnate	abruptly pinnate	abruptly pinnate
13	Leaflet venation	penninervis	penninervis	penninervis	penninervis	penninervis
14	Intervenium	parchment-like	parchment-like	parchment-like	parchment-like	parchment-like

Table 2. The result of ANOVA on the leaf morphological characteristics among five rambutan cultivars collected from Serang City, Banten

Morphological characteristics	Groups	Sum of squares	Mean of square	F	Sig.
Length of rachis	Between groups	122.866	30.716	1.271	0.299
	Within groups	894.224	24.168		
	Total	1017.090			
Length of petiole	Between groups	18.960	4.740	5.128	0.002
	Within groups	35.121	0.924		
	Total	54.080			
Length of leaflet	Between groups	110.375	27.594	6.854	0.000
	Within groups	152.976	4.026		
	Total	263.351			
Leaflet width	Between groups	24.683	6.171	6.397	0.000
	Within groups	36.657	0.965		
	Total	61.340			

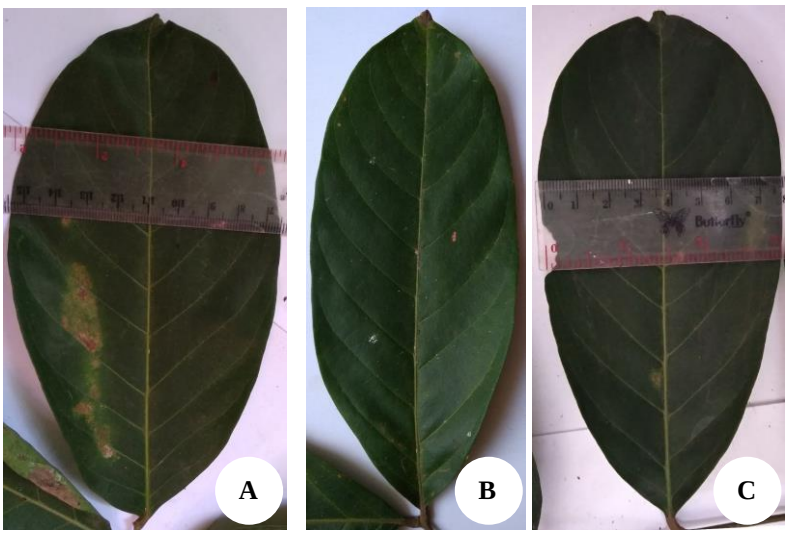

Figure 2. The leaflet shape variation among rambutan cutivars collected from Serang City region. A = Elliptical, B = elliptical-oblong, C = obovate

Figure 3. The leaflet apex variation among five rambutan cutivars collected from Serang City region. The picture showed a quarter part from the tip of leaflet. A: Acute; B: retuse; C: acuminate

Table 3. Post hoc test of Duncan's test result among five rambutan cultivars from Serang City, Banten

Cultivars	Length of leaflet (cm)	Leaflet width (cm)	Length of petiole (cm)
Rapiah	14.06 a	6.28 a	5.36 a
Aceh	16.40 b	8.09 b	6.44 b
Sinyonya	17.31 bc	8.43 b	7.00 b
Wild type	18.35 bc	8.04 b	7.13 b
Male tree	18.72 c	8.52 b	7.27 b

The ANOVA result of leaf morphological characters showed there was a significant difference (sig. 0.002) for the length of petiole among all cultivars observed (Table 2). The highest length of petiole was obtained from male tree (7.27±1.42 mm) (Table 1). The length of petiole in Aceh ranged from 5-8 mm, Rapiah 5-6 mm, Sinyonya 6-8 mm, wild type 6.5-8 mm, and male tree 5-9.5 mm. The post hoc test of Duncan's test result showed that Rapiah was significantly different with Aceh (sig. 0.036), Sinyonya (sig. 0.002), wild type (sig. 0.001), and male tree (sig. 0.000). .

Besides that, the ANOVA results also showed a significant difference for the leaflet length (sig.<0.001) and leaflet width (sig. <0.001) among all cultivars observed. The leaflet length in Aceh ranged from 11.95-18.85 cm, Rapiah 12.75-16.95 cm, Sinyonya 15.15-21.00 cm, wild type 13.20-22.25 cm, and male tree 16.90-21.90 cm. Meanwhile, the leaflet width in Aceh ranged from 5.85-9.20 cm, Rapiah 5.70-7.30 cm, Sinyonya 7.15-10.30 cm, wild type 5.80-9.60 cm, and male tree 7.70-10.55 cm. Male tree has the highest leaflet length (18. 72±1.71 cm) and leaflet width (8.52±0.95 cm), while Rapiah has a lowest leaflet length (14. 06±1.49 cm) and leaflet width (6.28±0.55 cm). The post hoc test of Duncan's test result showed that Rapiah was significantly different with all cultivars observed for leaflet length and width characters. These results showed that leaflet length, leaflet width and petiole length which might be used as specific characters to differ Rapiah from other cultivars.

Based on a dendrogram obtained from UPGMA method (Figure 4), the five cultivars observed had a similarity distance coefficient ranged between 81-100%. At the coefficient by 92% on dendrogram, all cultivars were separated into two main clusters, consisted of group A (Aceh, Rapiah, male tree) and group B (Sinyonya), while wild type was separated from other cultivars with a similarity coefficent of 81%. Based on the results of Windarsih and Efendi (2019), the fruits of Aceh and Rapiah have an adhesion of aryl to seed coat which less viscid, so the aryl is easy to peel off from seed coat, while the adhesion of aryl to seed coat on Sinyonya and wild type is viscid, so it is hard to peel off. It showed that the leaf morphological characters could distinguish some cultivars observed in a specific group which included in a popular cultivar with the aryl that easy to peel off from seed coat, i.e. Aceh and Rapiah which had a highest similarity distance by 100%. Male tree has a role as a donor of pollen for other cultivars and the result showed that it had a similarity distance of 100% with Aceh and Rapiah as popular cultivars. This results showed that leaf morphological characters were still useful to be used as identification tool to distinguish some rambutan cultivars from others. The success in distinguishing the cultivars using leaf morphological characters was also obtained by Sou et al. (2005). Manggabarani et al. (2018) also could show some rambutan cultivars into a specific group which including popular cultivars based on leaf morphological characters.

Based the results of this research, it showed that rambutan cultivars observed had variation in number of leaflets per leaf, rachis length, length of petiole, leaflet length, leaflet width, leaflet shape, and leaflet apex. The leaflet length, leaflet width and petiole length could be used as specific characters to differ Rapiah from other cultivars. Although several leaf morphological characters could be used to distinguish some cultivars from other, there was a possibility those characters also could be found on other cultivars. The molecular approach is needed to support the morphological character observation in distinguishing among rambutan cultivars.

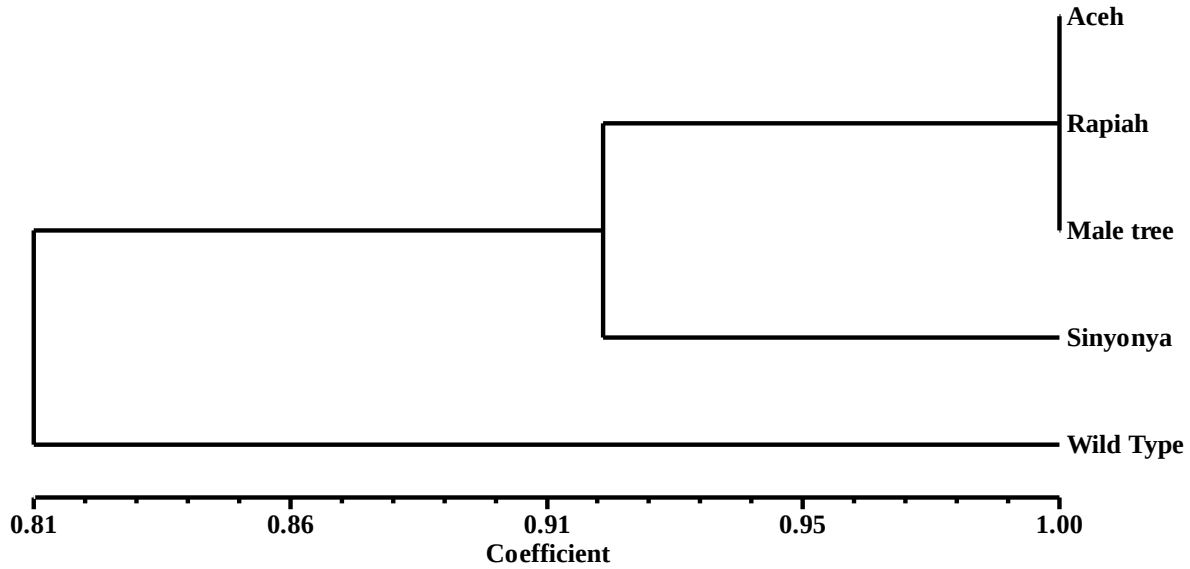

Figure 4. Dendrogram of five rambutan cultivars from Serang City region based on leaf morphological characters using UPGMA method

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