

## A Phenetic Analysis of *Korthalsia* spp. in Sumatra Based on Morphological Characters (Analisis Fenetik *Korthalsia* spp. di Sumatra Berdasarkan Karakter Morfologi)

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Info artikel:	ABSTRACT
<b>Keywords:</b> <i>Calamoideae</i> , <i>Korthalsia</i> , phenetic, rattan, Sumatra	<i>Korthalsia</i> (Blume) is a genus in the sub-family Calamoideae of the family Arecaceae. Research on a phenetic study of <i>Korthalsia</i> in Sumatra has never been published. The research was conducted to describe the specific characteristics of <i>Korthalsia</i> spp. in Sumatra and analyze their morphological character and similarity with a phenetic analysis. There were 85 herbarium specimens of <i>Korthalsia</i> deposited at the Herbarium Bogoriense (BO). Twenty-four vegetative and six generative characters were observed. Scoring was analyzed with a multinomial approach. The analysis was performed using the NTSys pc 2.02. The result showed that nine species of <i>Korthalsia</i> in Sumatra were distinguished based on their ocrea types, leaflets shape, and rachillae. The phenogram showed a similarity coefficient value of 0.53 for two main clusters, cluster A consisting of 4 species of <i>Korthalsia</i> ( <i>K. debilis</i> , <i>K. paucijuga</i> , <i>K. rigida</i> , and <i>K. rostrata</i> ) and Cluster B consisting of 5 species ( <i>K. echinometra</i> , <i>K. flagellaris</i> , <i>K. laciniosa</i> , <i>K. hispida</i> , and <i>K. robusta</i> ).
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### 1. Introduction

*Calamoideae* is a sub-family of *Arecaceae*. According to Dransfield et al. (2008), *Calamoideae* is divided into three tribes (*Eugeissoneae*, *Lepidocaryeae*, *Calameae*), including the rattans of Malesian region. This sub-family consists of nine genera, *Calamus*, *Ceratolobus*, *Daemonorops*, *Korthalsia*, *Myrialepis*, *Plectocomia*, *Plectocomiopsis*, *Pogonotium*, and *Retispatha*. All of these genera have a climbing habit, whether solitary or clustered. Rattan is a spiny palm with cirrus and/or flagella as a climbing tool (Henderson & Pitopang, 2018) with a scaly and shiny fruit surface.

Rattan, such as *Daemonorops*, *Calamus*, *Korthalsia*, *Ceratolobus*, and *Plectocomia* is a non-timber forest

product widely used with a high commercial value (Hidayat, Yoza, & Budiani, 2017). It is commonly used as a basic material for making ropes, baskets, mats, and furniture. Rattan is a tropical plant that is distributed in African and Asian tropics, including Indonesia (Dransfield, Tesoro, & Manokaran, 2002). Indonesia is one of the largest producers of rattan (Jasni, Damayanti, & Kalima, 2012). A 90% of rattan production in Indonesia is from natural forests in Sumatra, Sulawesi, and Kalimantan (Kalima & Jasni, 2015). Some species have been cultivated in Kalimantan, such as *Calamus caesius*, *C. javensis*, and *C. manan* (Armayanti, Herawatiningsih, & Tavita, 2016).

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Kontribusi penulis: **FM**: melakukan penelitian, analisis data, menyusun dan menulis karya tulis; **HR**: memberikan masukan selama penelitian, menyempurnakan karya tulis bidang taksonomi rotan dan sistematika penulisan; dan **P**: memberikan masukan selama penelitian, menyempurnakan karya tulis bidang taksonomi umum dan sistematika penulisan.

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*Korthalsia* was firstly described by Blume (1843). The taxonomic account of the genus was published by Dransfield (1980), Mattes et al. (1998), Mathew, Krishnaraj, Mohandas, & Lakshminarasimhan (2007), and Shahimi et al. (2019). *Korthalsia* is one of the genera with many species after *Calamus* and *Daemonorops*, with 28 species being found in Indonesia (Kusmana & Hikmat, 2015). *Korthalsia* is widespread in Indochina, Myanmar, Andaman Island, Southeast Asia (particularly in Sumatra and Sulawesi), and New Guinea (Dransfield et al., 2008). Sumatra is the region for which 9 species of *Korthalsia* are found, the third-highest species diversity after Borneo and Malay Peninsula (Shahimi et al., 2019).

*Korthalsia* is distinguishable among other rattan genera based on its morphological characters, ocrea, leaflet shape, and rachillae. The stem of *Korthalsia*, as of other rattans genera, is spiny covered with leaf sheath and indumentum without knee (Kalima & Rustiami, 2018). The ocrea of *Korthalsia* is distinct and various, distinguishing *Korthalsia* from other rattan genera or species. The ocrea can be tightly sheathing, inflated, divergent, and fibrous net-like ocrea. Generally, *Korthalsia* has the shape of a rhomboid leaflet with varying size and leaf sheath without knee.

A phenetic study of *Korthalsia* has never been conducted. Besides, the study of *Korthalsia* in Sumatra is poorly known, including the number of species and the similarity between species based on a phenetic analysis approach. Therefore, a study about *Korthalsia* in Sumatra is needed to provide basic information and the latest taxonomic status of *Korthalsia* in Sumatra. This study aimed to record the morphological variation of *Korthalsia* in Sumatra and its taxonomic status based on a phenetic approach.

## 2. Methodology

### 2.1. Plant Materials

Eighty-five collection-number herbarium specimens of *Korthalsia* were observed in this study. The specimens consisted of nine species, and those were: *K. debilis* Blume, *K. echinometra* Becc., *K. flagellaris* Miq., *K. hispida* Becc., *K. laciniosa* Mart., *K. paucijuga* Becc., *K. rigida* Blume, *K. robusta* Blume, and *K. rostrata* Blume. The specimens were collected from Sumatra and deposited in Herbarium Bogoriense (BO).

### 2.2. Method

Specimen images obtained directly from the Herbarium Bogoriense (BO) and living plant images were obtained from the Bogor Botanical Garden. The study was conducted from December 2019 to March 2020, using 85 collection numbers of *Korthalsia* dried herbarium specimens from Sumatra and virtual Kew Herbarium specimens documented on the JSTOR website ([www.plants.jstor.org](http://www.plants.jstor.org)).

The morphological characters examined are also based on various publications of Dransfield (1979), Dransfield (1980), Dransfield (1997), and Barfod & Dransfield (2013). Thirty morphometric characters were chosen for phenetic study using cluster analysis (Table 1). The term of botany followed the terminology of Harris & Harris (2001). Several morphometric characters and data analyzed followed Rustiami, Moge, & Tjitrosoedirdjo (2011) and Syam, Chikmawati, & Rustiami (2016). Phenetic classification is conducted based on similarity of taxa (Sneath & Sokal, 1973). Phenetic classification started with collecting measurement data on the chosen characters, called the *Operational Taxonomic Unit* (OTU). Scoring was conducted binary or multi-state data. Qualitative characters, *i.e.* ocrea types and leaflets shape were coded as (absent = 1; present = 2) and quantitative characters, *i.e.* high, diameter, length were characters

standardized to binary data that represented OTU.

### 2.3. Data Analysis

The similarity of 9 species of *Korthalsia* was analyzed using the NTSys ver. 2.02 (Rohlf, 1997). Thirty morphological characters were observed arranged in a matrix. Scoring was conducted as a multinomial using the Unweighted Pair Group Method with Arithmetic means (UPGMA) with the Similarity for Qualitative Data (SIMQUAL) procedure. The results of

these similarities were analyzed using the Sequential Agglomerative Hierarchical and Nested (SAHN) approach.

## 3. Results and Discussion

### 3.1. Morphological Characters

*Korthalsia* spp. has various morphology characters and can be distinguished from vegetative and generative characters. The morphological characters that distinguished this species of *Korthalsia* from the other are ocrea, leaflets, and inflorescences (Table 2).

**Table 1.** Morphological characters used in the cluster analysis.

No.	Character	No.	Character
<b>Vegetative Characters</b>		16.	Total leaflet on each side of rachis: < 20 (1), ≥ 20 (2)
1.	Plant height: < 20 m (1), ≥ 20 m (2)	17.	Petiole absent (1), present (2)
2.	Stem diameter with sheath: < 1 cm (1), ≥ 1 cm (2)	18.	Leaflet length: < 20 cm (1), ≥ 20 cm (2)
3.	Stem diameter without sheath: < 2 cm (1), ≥ 2 cm (2)	19.	Leaflet width: < 5 cm (1), ≥ 5 cm (2)
4.	Type of ocrea: tightly sheathing (1), inflated (2), divergent (3)	20.	Leaf length: < 1 m (1), ≥ 1 m (2)
5.	Ocrea length: < 10 cm (1), ≥ 10 cm (2)	21.	Transverse veinlets present: absent (1), present (2)
6.	Ocrea spine present: absent (1), present (2)	22.	Petiole length: < 10 cm (1), ≥ 10 cm (2)
7.	Spine length: < 2 cm (1), ≥ 2 cm (2)	23.	Rachis length: < 50 cm (1), ≥ 50 cm (2)
8.	Solitary or cluster spine: solitary (1), clustering (2)	24.	Cirrus length: < 1 m (1), ≥ 1 m (2)
9.	Leaflet shape: rhomboid (1), lanceolate (2), narrow lanceolate (3)	<b>Generative characters</b>	
10.	Leaflet apices shape: acuminate (1), acute (2)	25.	Inflorescence length: < 50 cm (1), ≥ 50 cm (2)
11.	Leaflet margins shape: praemorse (1), entire (2)	26.	Rachillae length: < 15 cm (1), ≥ 15 cm (2)
12.	Leaflet bases shape: cuneate (1), attenuate (2)	27.	Rachillae diameter: < 1 cm (2), ≥ 1 cm (2)
13.	Leaflet indumentum present: absent (1), present (2)	28.	Fruit shape: globe-shaped (1), egg-shaped (2)
14.	Different color on leaflet surface: different (1), same color (2)	29.	Fruit length: < 2 cm (1), ≥ 2 cm (2)
15.	Leaflet arrangement: alternate (1), opposite (2)	30.	Fruit diameter: < 1.5 cm (1), ≥ 1.5 cm (2)

Table 2. Scoring of *Korthalsia* spp. in Sumatra based on morphological characters

No.	Characters	Species								
		1	2	3	4	5	6	7	8	9
1.	Plant height: < 20 m (1), ≥ 20 m (2)	2	2	2	2	2	1	2	2	2
2.	Stem diameter with sheath: < 1 cm (1), ≥ 1 cm (2)	2	2	2	2	2	1	2	2	1
3.	Stem diameter without sheath: < 2 cm (1), ≥ 2 cm (2)	1	2	2	2	2	1	1	2	2
4.	Type of ocrea: tightly sheathing (1), inflated (2), divergent (3)	1	2	1	3	1	1	1	3	2
5.	Ocrea length: < 10 cm (1), ≥ 10 cm (2)	1	2	2	2	2	1	1	2	1
6.	Ocrea spine present: absent (1), present (2)	2	2	2	2	2	2	2	2	2
7.	Spine length: < 2 cm (1), ≥ 2 cm (2)	1	2	1	2	1	1	1	2	1
8.	Solitary or cluster spine: solitary (1), clustering (2)	1	2	1	1	1	1	1	1	1
9.	Leaflet shape: rhomboid (1), lanceolate (2), narrow lanceolate (3)	1	2	3	1	1	1	1	1	1
10.	Leaflet apices shape: acuminate (1), acute (2)	1	2	1	1	1	1	1	1	1
11.	Leaflet margins shape: praemorse (1), entire (2)	1	2	1	1	1	1	1	1	1
12.	Leaflet bases shape: cuneate (1), attenuate (2)	1	2	2	1	1	1	1	1	1
13.	Leaflet indumentum present: absent (1), present (2)	2	2	2	2	2	2	2	2	2
14.	Different color on leaflet surface: different (1), same color (2)	1	1	1	1	1	1	1	1	1
15.	Leaflet arrangement: alternate (1), opposite (2)	1	2	2	1	2	1	1	2	2
16.	Total leaflet on each side of rachis: < 20 (1), ≥ 20 (2)	1	2	2	1	1	1	1	1	1
17.	Petiole absent (1), present (2)	2	1	2	2	2	2	2	2	1
18.	Leaflet length: < 20 cm (1), ≥ 20 cm (2)	1	2	2	2	2	1	1	2	2
19.	Leaflet width: < 5 cm (1), ≥ 5 cm (2)	2	2	2	2	2	1	2	2	2
20.	Leaf length: < 1 m (1), ≥ 1 m (2)	1	2	2	2	2	1	1	2	2
21.	Transverse veinlets present: absent (1), present (2)	2	2	2	2	2	2	2	2	2
22.	Petiole length: < 10 cm (1), ≥ 10 cm (2)	1	2	2	2	2	1	2	2	2
23.	Rachis length: < 50 cm (1), ≥ 50 cm (2)	1	2	2	2	2	1	2	2	1
24.	Cirrus length: < 1 m (1), ≥ 1 m (2)	1	2	2	1	2	1	1	1	1
25.	Inflorescence length: < 50 cm (1), ≥ 50 cm (2)	1	2	2	1	2	1	2	1	1
26.	Rachillae length: < 15 cm (1), ≥ 15 cm (2)	1	2	1	2	2	1	2	1	2
27.	Rachillae diameter: < 1 cm (2), ≥ 1 cm (2)	1	2	1	2	1	1	1	2	1
28.	Fruit shape: globe-shaped (1), egg-shaped (2)	1	2	2	2	2	1	1	2	1
29.	Fruit length: < 2 cm (1), ≥ 2 cm (2)	1	2	2	2	2	1	1	2	1
30.	Fruit diameter: < 1.5 cm (1), ≥ 1.5 cm (2)	1	2	1	1	1	1	1	1	1

Remarks:

Species 1: *Korthalsia debilis*

Species 2: *Korthalsia echinometra*

Species 3: *Korthalsia flagellaris*

Species 4: *Korthalsia hispida*

Species 5: *Korthalsia laciniosa*

Species 6: *Korthalsia paucijuga*

Species 7: *Korthalsia rigida*

Species 8: *Korthalsia robusta*

Species 9: *Korthalsia rostrata*

**Ocrea**

The ocrea size of *Korthalsia* in Sumatra ranged 0.5–50 cm. Ocrea of *Korthalsia* in Sumatra has three variations, tightly sheathing ocrea (*K. debilis*, *K. flagellaris*, *K. laciniosa*, *K. rigida*, *K. paucijuga*), inflated ocrea (*K. echinometra*, *K. rostrata*), and divergent ocrea (*K. hispida*, *K. robusta*) (Figure 1).

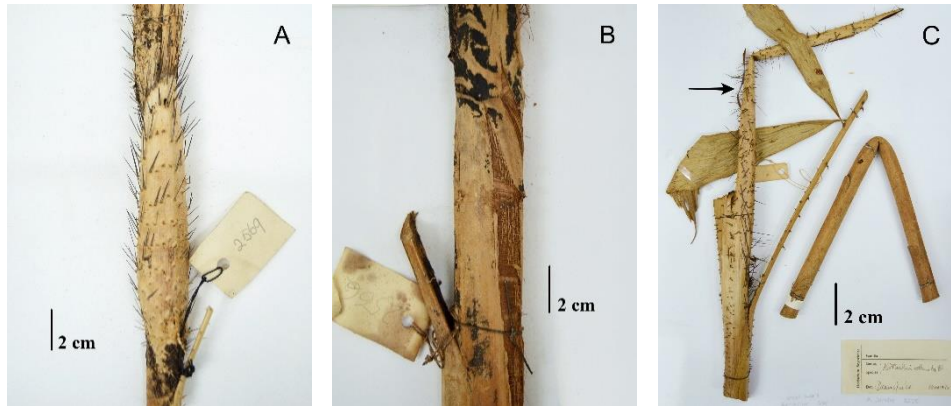
**Leaflets**

The leaflet size of *Korthalsia* in Sumatra ranged 15 – 30 cm long. Leaflet' shape of *Korthalsia* in Sumatra has three variations. Those are rhomboid shape (*K. debilis*, *K. rigida*, *K. paucijuga*, *K. laciniosa*, *K. robusta*, *K. rostrata*), lanceolate shape (*K. flagellaris*), and narrow lanceolate shape (*K. echinometra*) (Figure 2).

**Inflorescence**

The inflorescence size of *Korthalsia* in Sumatra ranged 9 – 20 × 0.5 – 2 cm. The inflorescence shape of *Korthalsia* in

Sumatra has three variations, thin, thick, and very thick. The availability of flowering specimens is still limited on *Korthalsia* in Sumatra (BO) (Figure 3).



**Figure 1.** Ocrea types *Korthalsia* in Sumatra. A. Tightly sheathing ocrea (2569; BO). B. Inflated ocrea (2566; BO). C. Divergent ocrea (8295; BO).



**Figure 2.** Leaflets shape of *Korthalsia* in Sumatra. A. Rhomboid shape (Cin 02 D; BO). B. Lanceolate shape (2566; BO). C. Narrow lanceolate shape (NS 29; BO).



**Figure 3.** Inflorescences variation of *Korthalsia* in Sumatra. A. Thin rachillae (6722; BO). B. Thick rachillae (7361; BO). C. Very thick rachillae (8295; BO).

Based on the morphological characters observed, the identification key to species of *Korthalsia* in Sumatra was assigned.

Key to species of the *Korthalsia* in Sumatra

1. a. Ocrea < 10 cm long ..... 2  
    b. Ocrea ≥ 10 cm long ..... 5
2. a. Inflated ocrea ..... *K. rostrata*  
    b. Tightly sheathing ocrea ..... 3
3. a. Leaf < 1 m long ..... 4  
    b. Leaf ≥ 1 m long ..... *K. rigida*
4. a. Stem diameter < 1 cm without ocrea  
    ..... *K. paucijuga*  
    b. Stem diameter ≥ 1 cm without ocrea  
    ..... *K. debilis*
5. a. Leaflet shape narrow lanceolate ....  
    ..... *K. echinometra*  
    b. Leaflet shape rhomboid ..... 6
6. a. Inflorescence length ≥ 50 cm ..... 7  
    b. Inflorescence < 50 cm ..... 8
7. a. < 20 leaflets each side of rachis .....  
    ..... *K. laciniosa*  
    b. ≥ 20 leaflets each side of rachis .....  
    ..... *K. flagellaris*
8. a. *Rachillae* length ≥ 15 cm .....  
    ..... *K. hispida*  
    b. *Rachillae* length < 15 cm .....  
    ..... *K. robusta*

**3.2. Taxonomic Treatment**

A total of nine species of *Korthalsia* in Sumatra with different and distinguishable characters were recognized, *i.e.* *K. debilis*, *K. echinometra*, *K. flagellaris*, *K. hispida*, *K. laciniosa*, *K. paucijuga*, *K. rigida*, *K. robusta*, and *K. Rostrata*.

1. *Korthalsia debilis* Blume, Rumphia 2: 169 (1843)

It can climb rattan to 20 m. *Stem* with sheath 0.4 – 1.3 cm in diameter, without sheath 0.8 – 1.7 cm in diameter. *Leaf* 50 – 100 cm long including petiole, rachis, and cirrus; sheath green with solitary spines, spines 0.2 – 0.3 cm long; ocrea 2 – 8 cm long, tightly sheathing, net-like ocrea; petiole 2 – 7 cm long; cirrus 20 – 35 cm long; rachis 23 – 32 cm, grapnel

spines; 3 – 6 leaflets each side of rachis, alternate regularly arranged, *petiolules* present, rhomboid shape, 12 – 19 × 4 – 9 cm, leaflets green and grey greenish undersurface, indumentum present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* branched; *rachillae* 9 – 0.4 cm. *Fruit* not available.

**Habitat.** Primary forest, dipterocarp forest. 19 - 1200 m altitude.

**Distribution.** Brunei Darussalam, Kalimantan, Sarawak, Sumatra.

**Vernacular name.** Wae melandeng (Desa Dendang, Sumatra Utara), rautan buai (Belitung Timur), rautan dan (Belitung).

**Uses.** Furniture

**Notes.** *K. debilis* almost similar with *K. rigida*, it has a rhomboid shape leaflet with similar size, but *K. rigida* has broader leaflets than *K. debilis*.

**Specimens examined. Sumatra: Aceh,** Kutacane, Biak Mentelang, 450 m alt., 14 Feb 1980, *J.P. Moge* 1997, sterile (BO); **Jambi,** Bukit Barisan, 25 km from Penuh river, 1.200 m alt., 30 Jul 1972, *J. Dransfield* 2725, sterile (BO); **Kepulauan Bangka Belitung,** Lasar Village, Membalong, Belitung, 19-20 m alt., 16 Mar 2017, *Deri Andayani* DE 12D, sterile (BO); Limbungan Village, Gantung, Belitung, 11 m alt., 22 Mar 2017, *Cynthia Paramita* Cin 02D, sterile (BO); **South Sumatra,** Ranau Lake, Setumpau, 800-900 m alt., 16 November 1983, *J.J. Afriastini* 0803, sterile (BO); **North Sumatra,** Dendang Village, Stabat, Langkat, 55 m alt., 23 Mar 2011, *Fitri* V-3 008, sterile (BO); Ulu Besitang, Tanjung Pura, 50 m alt., 14 Aug 1971, *J. Dransfield & D. Saerudin* 1844, sterile (BO).

2. *Korthalsia echinometra* Becc., Malesia 2: 66 (1884)

**Synonym.** *Korthalsia angustifolia* var. *gracilis* Miq., Palm. Archip. Ind.: 16 (1868); *Korthalsia horrida* Becc., Malesia 2: 66 (1884).

It can climb rattan to 40 m. *Stem* with sheath 1.2 - 4 cm in diameter, without

sheath 0.8 – 2 cm in diameter. *Leaf* 1.2 – 2 m long including petiole, rachis, and cirrus; sheath green with grey indumentum, solitary triangular black spines, spines to 6 cm long; ocrea 10 - 20 cm long, inflated ocrea; petiole 10 - 30 cm long, covered brown indumentum; cirrus 0.5 – 1.2 m long; rachis 0.5 – 1 m, grapnel spines; 11 – 20 leaflets each side of rachis, opposite regularly arranged, *petiolules* absent, narrowly lanceolate shape, 24.5 – 33 × 2 – 3 cm, leaflets green and grey greenish undersurface, indumentum present, distal margin entire, apices shape acute, basis shape attenuate, transverse veinlets present. *Inflorescence* 0.6 – 1.2 m long, branched; 1 – 4 *rachillae*, *rachillae* 11 – 20 × 0.6 – 1.5 cm. *Fruit* oblong, 2 – 2.5 × 1.5 cm, covered vertical rows of red-brownish.

**Habitat.** Primary forest, dipterocarp forest. 3 - 800 m altitude.

**Distribution.** Brunei Darussalam, Malay Peninsula, Sumatra.

**Vernacular name.** rotan udang (Riau), rotan dangau (Mentawai), ketang cacing (Aceh), ronga (Mentawai)

**Uses.** Basic materials of chairs.

**Notes.** *K. echinometra* is a very distinctive species. It has a narrow lanceolate leaflet and an inflated ocrea with long black spines. The ocrea of *K. echinometra* is inhabited by ants.

**Specimens examined. Sumatra: Aceh,** Sosor Village, Sub-district of Simpang Kanan, Aceh Singkil, 5 m alt., 18 August 2013, *Nasrianti Syam & M. Nasir Syam* NS29, sterile (BO); **Bengkulu,** Kepahiang Nature Preserve, Sub-district of Curup, Kepahiang Regency, 800 m alt., *J. Dransfield* 1231, sterile (BO); **Kepulauan Bangka Belitung,** Sub-district of Belinyu, Bangka Regency, 9 November 1914, *W. Grashoff* 79, sterile (BO); **Riau,** Sub-district of Kuala Indragiri, Indragiri Hilir Regency, 600 m alt., 27 April 1939, *Dr. P. Buwalda* 6722, fruiting (BO); Sub-district of Kuala Cenaku, Indragiri Hulu Regency, 3 m alt., 10 January 1940, *Rapii* BB.31.244, fruiting (BO); **West Sumatra,**

Teiteibati National Park, Siberut Island, 100 m alt., July 1992, *J.J. Afriastini* 1901, sterile (BO); Teitei Lemori, Madobag Village, Sub-district of South Siberut, Siberut Island, 100 m alt., 29 June 1993, *J.J. Afriastini & A. Adhikerana* 2569, fruiting (BO); **South Sumatra,** Ogan Komering Ulu Regency, 80 m alt., 22 August 1915, *W. Grashoff* 572, flowering (BO); Banyuasin Regency, 20 m alt., 11 October 1915, *W. Grashoff* 701, flowering (BO); Palembang City, Sub-district of Sematang Ulu, 150 m alt., 19 February 1915, *W. Grashoff* 197, sterile (BO); **North Sumatra,** Sub-district of Ulu Besitang, Tanjung Pura Regency, 50 m alt., 15 August 1971, *J. Dransfield & D. Saerudin* 1849, sterile (BO).

3. *Korthalsia flagellaris* Miq., Fl. Ned. Ind., Eerste Bijv. 3: 591 (1861)

**Synonym.** *Korthalsia rubiginosa* Becc., Malesia 2: 72 (1884)

It can climb rattan to 40 m. *Stem* with sheath 2 – 4 cm in diameter, without sheath 1.5 – 2.5 cm in diameter; internodes 30 cm. *Leaf* 1.5 – 3 m long including petiole, rachis, and cirrus, smooth solitary spines; ocrea 10 – 30 cm long, tightly sheathing ocrea, membranous lateral; petiole 10 – 17 cm long; cirrus 0.5 – 1.5 m long; rachis 0.5 – 1.3 m, grapnel spines; leaflets absent when juvenile, distal margin of leaf rounded, the leaf will develop into leaflets when mature; 8 – 20 leaflets each rachis, opposite regularly arranged, *petiolules* present, lanceolate shape, 30 – 40 × 3 – 4.5 cm, leaflets blue-greenish and brownish undersurface, indumentum present, distal margin *praemorse*, apices shape acuminate, basis shape attenuate, transverse veinlets present. *Inflorescence* 75 cm long, branched; *rachillae* 9 – 12 × 0.7 cm. *Fruit* oblong, 2 × 1.2 cm, covered vertical rows of brown.

**Habitat.** Peat swamp forest. 3 - 50 m altitude.

**Distribution.** Brunei, Malay Peninsula, Sumatra

**Vernacular name.** Rotan dahan (Sumatra Barat), rotan batu (Jambi), rautan bidai (Belitung), wae den (Belitung).

**Uses.** Baskets.

**Notes.** *K. flagellaris* is a distinctive species because it has a bluish-green leaflet. The lanceolate leaflet shape with praemorse margin is one of the distinctive character of this species.

**Specimens examined. Sumatra: Jambi,** Berbak Wildlife Reserve, near Air Hitam river, 4 m alt., 13 July 1972, *J. Dransfield* 2566, 2586, sterile (BO); **Kepulauan Bangka Belitung,** Pebuar Village, Sub-district of Jebus, Bangka Barat Regency, 43 m alt., 4 April 2011, *Fitri V-3 021*, sterile (BO); Kembiri Village, Sub-district of Membalong, Belitung Regency, 18 m alt., 15 March 2017, *Deri Andayani DE 08R*, sterile (BO); Belitung, 1913, *Heyne 2*, sterile (BO); Sub-district of Belinyu, Bangka Regency, 50 m alt., 25 September 1914, *Grashoff 8*, sterile (BO); **Kepulauan Riau,** Singkep Island, Lingga Regency, 40 m alt., 7 August 1919, *H.A.B. Binnemeyer 7361*, flowering (BO); **Riau,** Bengkalis Regency, 3 m alt., 13 November 1919, *Beguin 468*, sterile (BO); **West Sumatra,** 17 January 1935, *Houtv. J.H.de Haan 50*, sterile (BO), 3 January 1935, *Houtv. J.H. de Haan 16*, sterile (BO); **South Sumatra,** Banyuasin Regency, 20 m alt., 16 November 1915, *Grashoff 825*, sterile (BO); Palembang City, 1914, *Heyne 19*, sterile (BO).

4. *Korthalsia hispida* Becc., Malesia 2: 71 (1884)

It can climb rattan to 30 m. *Stem* with sheath 1.5 – 2.5 cm in diameter, without sheath 0.8 – 1.5 cm in diameter; internodes 10 – 20 cm. *Leaf* 1 – 1.8 m long including petiole, rachis, and cirrus; sheath light green with brown indumentum, solitary triangular black spines, spines 2 – 3 cm long; ocrea 17 – 25 × 3 – 5 cm, divergent ocrea, armed with 1 – 3 cm; petiole 14 – 20 cm long, covered brown indumentum; cirrus 60 – 90 cm long; rachis 0.3 – 1.5 m, grapnel spines; 5

– 8 leaflets each side of rachis, alternate regularly arranged, *petiolules* present, rhomboid shape, 16 – 19 × 5 – 8 cm, leaflets light green and whitish undersurface, indumentum present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* 30 – 50 cm long, branched; 1 – 3 *rachillae*, *rachillae* 15 – 20 × 1 – 1.5 cm. *Fruit* round to oblong, 1.8 – 2.2 × 0.6 – 0.9 cm, covered vertical rows of red-brownish.

**Habitat.** Dipterocarp forest, near the river, lowland hills. 5 - 400 m altitude.

**Distribution.** Borneo, Malay Peninsula, Sumatra

**Vernacular name.** Ketang udang (Aceh)

**Uses.** Basic materials of chairs.

**Notes.** *K. hispida* and *K. robusta* are indistinguishable species. This species has a divergent ocrea and rhomboid shape leaflet with a similar size. It can be distinguished from generative characters, *rachillae* length of both is different.

**Specimens examined. Sumatra: Aceh,** Sosor Village, Sub-district of Simpang Kanan, Aceh Singkil Regency, 5 m alt., 18 August 2013, *Nasrianti Syam & M. Nasir Syam NS 28*, sterile (BO); Bukit Plawi, Sub-district of Peureulak, East Aceh Regency, 30 m alt., April 1931, *Nainggolan s.n.*, sterile (BO); **Jambi,** Kerinci Regency, Penuh river, 400 m alt., 22 July 1972, *J. Dransfield 2620*, flowering (BO).

5. *Korthalsia laciniosa* Mart., Hist. Nat. Palm. III: 211 (1845)

**Synonym.** *Korthalsia andamanensis* Becc., Malesia 2: 76 (1884); *Korthalsia grandis* Ridl., Mat. Fl. Malay. Penins. 2: 217 (1907); *Korthalsia scaphigera* Kurz, Forest Fl. Burma 2: 513 (1877); *Korthalsia teysmanii* Miq., Fl. Ned. Ind., Eerste Bijv.: 591 (1861); *Korthalsia wallichiifolia* (Griff.) H. Wendl. in O.C.E.de Kerchove de Denterghem, Palmiers: 248 (1878).

It can climb rattan to 50 m. *Stem* with sheath 3 – 7 cm in diameter, without



sheath 2 – 6 cm in diameter; internodes 30 cm. *Leaf* 2.5 m long including petiole, rachis, and cirrus; sheath whitish with indumentum, smooth solitary spines, spines 0.6 cm long; ocrea 10 – 15 cm, tightly sheathing ocrea, membranous; petiole 6 – 8 cm long; cirrus 1.2 m long; rachis 0.5 – 1.2 m, grapnel spines; 6 – 8 leaflets each side of rachis, opposite regularly arranged, *petiolules* present, rhomboid shape, 15 – 30 × 12 – 19 cm, different color on surface, indumentum present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* 50 – 75 cm long, branched; *rachillae* 10 – 15 × 0.5 – 1 cm. *Fruit* oblong, 2 × 1.5 cm. **Habitat.** Dipterocarp forest. 250 - 1000 m alt.

**Distribution.** Andaman Island, Nicobar Island, Myanmar, Thailand, Indochina, Malay Peninsula, Sumatra, Java, the Philippines.

**Vernacular name.** Uwi dahanan (Palembang).

**Uses.** Not recorded.

**Specimens examined. Sumatra:** **Lampung,** Lampung, 914, *Gusdorf* 317, 311, sterile (BO); **South Sumatra,** Kelam Hill, Curup Village, Sub-district of Tanah Abang, Penukal Abab Lematang Ilir Regency, 1.000 m alt., 13 February 1971, *J. Dransfield* 1244, sterile (BO); Sub-district of Muaradua, Palembang City, 250 m alt., 1 June 1915, *Grashoff* 425, flowering (BO); Palembang City, Sub-district of Sematang Ulu, 150 m alt., 19 February 1915, *Grashoff* 199, flowering (BO); **North Sumatra,** Lawang Hill, Sub-district of Bahorok, Langkat Regency, 600 m alt., 27 February 1973, *J. Dransfield* 3367, sterile (BO).

6. *Korthalsia paucijuga* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 121, 122 (1918)

It can climb rattan to 30 m. *Stem* with sheath 0.6 – 1 cm in diameter, without sheath 0.5 cm in diameter; internodes 10 cm. *Leaf* 80 cm long

including petiole, rachis, and cirrus; smooth solitary spines, spines 0.1 cm long; ocrea 0.5 – 1.5 cm, tightly sheathing ocrea; petiole 1 – 3 cm long; cirrus 30 cm long; rachis 50 cm, grapnel spines; 6 – 8 leaflets each side of rachis, opposite regularly arranged, *petiolules* present, rhomboid to lanceolate shape, 15 – 20 × 4 – 5.5 cm, different color on surface, indumentum present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* 20 cm long, branched; *rachillae* 8 × 0.4 cm. *Fruit shapes* round to oblong, 1.2 × 1 cm.

**Habitat.** Peatland forest. 4 m altitude.

**Distribution.** Sumatra, Borneo

**Vernacular name.** Rotan tai ayam (Sumatra Barat)

**Uses.** Not recorded.

**Notes.** *K. paucijuga* has any similar characters with *K. debilis*, but the species can be distinguished from the size of the plant and stem diameter. *K. paucijuga* has smaller stem diameter than *K. debilis*.

**Specimens examined. Sumatra: Jambi,** Berbak Wildlife Reserve, near Air Hitam river, 4 m alt., 13 July 1972, *J. Dransfield* 2564, sterile (BO); **West Sumatra,** 16 January 1935, *Houtv.J.H.de Haan* 47, sterile (BO).

7. *Korthalsia rigida* Blume, Rumphia 2: 167 (1843)

**Synonym.** *Korthalsia ferox* var. *malayana* Becc. in J.D.Hooker, Fl. Brit. India 6: 476 (1893); *Korthalsia hallieriana* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 142 (1918); *Korthalsia paludosa* Furtado, Gard. Bull. Singapore 13: 313 (1951); *Korthalsia polystachya* Mart., Hist. Nat. Palm. 3: 210 (1845).

It can climb rattan to 50 m. *Stem* with sheath 1.5 – 2.5 cm in diameter, without sheath 1 – 2 cm in diameter; internodes 20 cm. *Leaf* 1.5 – 2 m long including petiole, rachis, and cirrus; sheath green with whitish indumentum, solitary triangular brown spines, spines 0.2 – 3 cm long; ocrea 16 – 50 × 3 – 7 cm,

divergent ocrea; petiole 10 – 35 cm long; cirrus 0.75 – 1.75 m long; rachis 0.65 – 1.35 m long, grapnel spines; 6 – 10 leaflets each side of rachis, alternate regularly arranged, *petiolules* present, rhomboid shape, 9 – 15 × 6 – 8 cm, leaflets dark green and whitish undersurface, indumentum present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* 70 – 80 cm long, branched; *rachillae* up to 10, *rachillae* 15 – 30 × 0.5 cm. *Fruit* round, 2 cm wide, covered vertical of rows green brownish.

**Habitat.** Lowland hills, dipterocarp forest, primary forest. 3 - 1300 m altitude.

**Distribution.** Thailand, Malaya, Sumatra, Borneo, Palawan

**Vernacular name.** Rotan danan (Aceh), rotan kubin (Sumatra Barat), rotan belidang (Riau), rotan melandang (Belitung).

**Uses.** Furniture

**Specimens examined. Sumatra: Aceh,** Kemiri Mountain, Aceh Southeast, 700 m alt., 21 November 1975, *J.P. Moge* 622, sterile (BO); Gayo Luwes Regency, 744 m alt., 2 November 1997, *Pak Ikram Sangaji & Sasha Barrow* 25, sterile (BO); **Kepulauan Bangka Belitung,** Permis Hill, Sub-district of Simpang Rimba, South Bangka Regency, 207 m alt., 23 March 2011, Leg. ign. *SHER 010*, sterile (BO); Sub-district of Belinyu, Bangka Regency, 80 m alt., 30 October 1914, *W. Grashoff* 60, sterile (BO); Sub-district of Lubuk Besar, Bangka Regency, 20 m alt., 26 August 1949, *Kostermans & Anta* 133, flowering (BO); Belitung Regency, 1913, *Heyne* 4, flowering (BO); Gunung Permisan, Sub-district of Simpang Rimba, South Bangka Regency, 300 m alt., *H.A.B. Binnemeyer* 2025, sterile (BO); **Riau,** Sub-district of Kuala Cenaku, Indragiri Hulu Regency, 3 m alt., 15 January 1919, *Rapii* BB.31.267, BB.31.268, sterile (BO); **West Sumatra,** Rimbo Panti Nature Preserve, Sub-district of Panti, Pasaman, 35 km to north from Lubuk Sikaping, 200-500 m alt., 5 August 1999,

*Nurainas* N 1354, flowering (BO); Talamau Mountain, Sub-district of Jorong Bungo Tanjung, Pasaman, 20 June 2011, *H. Rustiami, A. Haryadi, M. Ardiyani, Y. Santika, H. Handika, Wahyudi, & Daniel* HR 1854, sterile (BO); Muro Kulampi, Sijunjung Regency, 400 m alt., 26 February 1974, *J. Dransfield & J.P. Moge* 3960, fruiting (BO); **South Sumatra,** Musi Rawas Regency, 50 m alt., 19 March 1916, *W. Grashoff* 1006, sterile (BO); Ogan Komering Ulu Regency, 80 m alt., 23 August 1915, *W. Grashoff* 584, sterile (BO); Palembang, Sub-district of Muaradua, 250 m alt., 12 June 1915, *W. Grashoff* 466, 30 July 1915, *W. Grashoff* 552, sterile (BO); **North Sumatra,** Lawang Hill, Sub-district of Bahorok, Langkat Regency, 500 m alt., 17 February 1973, *J. Dransfield* 3199, fruiting, 3201, sterile, 3202, flowering (BO), 20 February 1973, *J. Dransfield* 3257, fruiting (BO); Sub-district of Sibolangit, 400-550 m alt., 2 October 1927, *J.A. Lorzing* 12123, fruiting (BO); Sibualbuali Mountain Madurana track, Sipirok, 1.300 m alt., 20 May 1993, *J.J. Afriastini* 2400, fruiting (BO).

8. *Korthalsia robusta* Blume, Rumphia 2: 170 (1843)

**Synonym.** *Korthalsia macrocarpa* Becc., Ann. Roy. Bot. Gard. (Calcutta) 12(2): 149 (1918); *Korthalsia squarrosa* Becc., Philipp. J. Sci., C 4: 620 (1909).

It can climb rattan to 40 m. *Stem* with sheath 2 – 3.5 cm in diameter, without sheath 1.4 – 2 cm in diameter; internodes 25 cm. *Leaf* 1.5 – 3 m long including petiole, rachis, and cirrus; sheath green with brown indumentum, solitary triangular black spines, spines 0.2 – 3 cm long; ocrea 4 – 6 cm, tightly sheathing ocrea; petiole 10 – 25 cm long; cirrus 0.75 – 1 m long; rachis 30 – 80 cm, grapnel spines; 5 – 7 leaflets each side of rachis, opposite regularly arranged, *petiolules* present, rhomboid shape, 20 – 27 × 5 – 13 cm, leaflets dark green and whitish undersurface, indumentum

present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* 35 – 55 cm long, branched; *rachillae* 13 – 16 × 1 – 1.2 cm. *Fruit* round, 1.8 – 2.3 × 0.9 – 1.6 cm, covered vertical of rows brownish.

**Habitat.** Lowland dipterocarp forest. 4 - 450 m altitude.

**Distribution.** Borneo, Philippine, Sumatra.

**Uses.** Not recorded.

**Notes.** *K. robusta* and *K. hispida* have divergent ocrea, and ants can inhabit it.

**Specimens examined. Sumatra: Jambi,** Berbak Wildlife Reserve, near Air Hitam river, 4 m alt., 13 July 1972, *J. Dransfield* 2567, sterile (BO); **Lampung,** Sub-district of Kota Agung, Tanggamus Regency, 350-450 m alt., 9 May 1968, *M. Jacobs* 8295, flowering (BO); Karangberak village, Sub-district of Pematang Sawah, Tanggamus Regency, 100 m alt., 20 February 1971, *J. Dransfield* 1258, sterile (BO).

9. *Korthalsia rostrata* Blume, Rumphia 2: 168 (1843)

**Synonym.** *Korthalsia lobbiana* H.Wendl., Bot. Zeitung (Berlin) 17: 174 (1859); *Korthalsia machadonis* Ridl., Mat. Fl. Malay. Penins. 2: 216 (1907); *Korthalsia scaphigera* Mart. Hist. Nat. Palm. 3(ed. 2): 211 (1845).

It can climb rattan to 20 m. *Stem* with sheath 0.5 – 1.5 cm in diameter, without sheath 0.4 – 0.9 cm in diameter; internodes 10 - 12 cm. *Leaf* 0.4 – 1 m long including petiole, rachis, and cirrus; sheath green with brown indumentum, solitary triangular brown-yellowish spines, spines 0.1 – 0.4 cm long; ocrea 2.5 – 5 × 1.3 cm, inflated ocrea, brown, armed with 0.2 – 0.5 cm; petiole 3 – 18 cm long; cirrus 0.3 – 1.25 m long; rachis 0.25 – 1.45 m, grapnel spines; 3 – 7 leaflets each side of rachis, opposite regularly arranged, *petiolules* present, rhomboid shape, 11 – 20 × 5 – 10 cm, leaflets dark green and whitish undersurface, indumentum

present, distal margin *praemorse*, apices shape acuminate, basis shape cuneate, transverse veinlets present. *Inflorescence* 30 – 70 cm long, branched; *rachillae* 2 – 4, *rachillae* 8 – 18 × 0.5 – 0.8 cm, covered brown indumentum. *Fruit* oblong, 2 – 2.5 × 1.2 – 1.7 cm, covered vertical of rows brown.

**Habitat.** Lowland dipterocarp forest. 5 - 550 m altitude.

**Distribution.** Borneo, Malay Peninsula, Sumatra, Singapore

**Vernacular name.** Rotan semut (Bengkulu), wae semut (Riau), rotan kawan (Aceh)

**Uses.** Baskets

**Notes.** *K. rostrata* has an inflated ocrea like *K. echinometra*, but the ocrea of *K. rostrata* is shorter than *K. echinometra*. The ocrea of *K. rostrata* is inhabited by ants.

**Specimens examined. Sumatra: Aceh,** Meulaboh City, West Aceh Regency, 73 m alt., 21 October 1997, *Pak Ikram Sangaji & Sasha Barow* 6, sterile (BO); Julok Rayeuk village, Sub-district of Indra Makmur, East Aceh Regency, 100 m alt., May 1931, *Nainggolan* s.n., sterile (BO); Simpang Kiri Mountain, Sub-district of Simpang Kiri, Subulussalam, collected from Kampung Adan, area Tangan-Tangan, 23 October 1997, *Pak Ikram Sangaji & Sasha Barow* 11, sterile (BO); **Bengkulu,** Bukit Barisan Setalan National Park, Kaur Tengah, South Bengkulu, 400 m alt., 17 November 1995, *A. Keim* 14, fruiting (BO); **Kepulauan Riau,** Bakung Island, Lingga, 5 m alt., 19 August 1919, *H.A.B. Bünnemeyer* 7580, flowering (BO); **Lampung,** Bukit Barisan Selatan National Park, Kayongarang, Sukaraja Village, Sub-district of Semaka, 550 m alt., 27 August 2008, *D. Arifiani, R. Mahyuni & Sugianto* DA902, sterile (BO); **Riau,** Sub-district of Kuala Cenaku, Indragiri Hulu Regency, 10 January 1940, *Rapii* BB.31.249, BB.31.250, flowering (BO); Belit Village, Sub-district of Rambah, Rokan Hulu Regency, 65 m alt., 14 March 2011, *Fitri* V-3 027, sterile

(BO); **West Sumatra**, Sub-district of Tapan, 39 km Penuh river street, 500 m alt., 14 March 1974, *J. Dransfield & J.P. Moge* 4162, fruiting (BO); Muro Kulampi, Sijunjung, 400 m alt., 26 February 1974, *J. Dransfield & J.P. Moge* JD.3957, sterile (BO); Rimbo Panti Nature Preserve, Sub-district of Panti, Pasaman, 35 km to north from Lubuk Sikaping City, 200-500 m alt., 8 May 1999, *Nurainas* N 1355, sterile (BO); **South Sumatra**, Banyuasin Regency, 20 m alt., 26 September 1915, *W. Grashoff* 634, flowering (BO); Palembang, 1914, *Heyne* 22, flowering (BO); Musi Rawas Regency, 100 m alt., 10 March 1916, *W. Grashoff* 1003, flowering (BO); **North Sumatra**, Landak river, Lawang hill, Sub-district of Bahorok, Langkat, 250 m alt., 5 February 1980, *H. Wiriadinata & Maskuri* 669, fruiting (BO); 6 February 1980, *H. Wiriadinata & Maskuri* 682, flowering (BO); Sub-district of Ulu Besitang, Tanjung Pura Regency, 50 m alt., 14 August 1971, *J. Dransfield & D. Saerudin* 1847, sterile (BO); Bukit Lawang, Sub-district of Bahorok, Langkat, 550 m alt., 17 February 1973, *J. Dransfield* 3204, fruiting (BO).

### 3.3. Phenetic analysis

Phenogram formed 2 main cluster, *i.e.* Cluster A consisting of 4 species (*K. debilis*, *K. paucijuga*, *K. rigida*, *K. rostrata*) and Cluster B consisting of 5 species (*K. echinometra*, *K. flagellaris*, *K. laciniosa*, *K. hispida*, *K. robusta*) (Figure 4). Each species in the cluster was associated based on their morphological characters with a coefficient similarity of 0.53.

Cluster A was divided into two subclusters with a coefficient similarity value of 0.53. *Korthalsia debilis*, *K. paucijuga*, *K. rigida*, and *K. rostrata* had the same morphological character based on the ocrea's length (< 10 cm). *K. debilis*, *K. paucijuga*, and *K. rigida* had a tightly sheathing ocrea shaped. In contrast, *K. rostrata* had an inflated ocrea. *Korthalsia*

*debilis* and *K. paucijuga* had a similar morphology character *i.e.* stem diameter < 2 cm with sheath, spine < 2 cm long, solitary spine, leaf < 1 m long, *petiolules* present, rachis < 50 cm long, cirrus < 1 m long. Both species are almost indistinguishable, but *Korthalsia paucijuga* is smaller than *K. debilis*.

Cluster B was divided into two subclusters with a coefficient similarity value of 0.61. Group I consisted of only *K. echinometra*. The character of *K. echinometra* that distinguished this species from other *Korthalsia* were inflated ocrea ( $\geq 10$  cm long), narrow lanceolate leaflets, and *petiolules* absent. Meanwhile, Group II that consisted of 4 species (*K. flagellaris*, *K. laciniosa*, *K. hispida*, *K. robusta*) had similar morphology *i.e.* clustering rattan climbing to  $\geq 20$  m, stem diameter  $\geq 1$  cm without ocrea,  $\geq 2$  cm with sheath, ocrea  $\geq 10$  cm long, leaf  $\geq 1$  m long, leaflet  $\geq 20$  cm long, rachis  $\geq 50$  cm long.

Group II in Cluster B was divided into two groups. The first group consisted of *K. flagellaris* and *K. laciniosa*, while the second group consisted of *K. hispida* and *K. robusta*. The characters that distinguished the first group from the second group were ocrea types, spine length, cirrus length, clustering rattan climbing  $\geq 20$  m, and tightly sheathing ocrea with  $\geq 10$  cm long. *K. hispida* and *K. robusta* had similar characters, such as stem diameter with  $\geq 1$  cm without ocrea, inflated ocrea with  $\geq 10$  cm long, spine  $\geq 2$  cm long. The research about *K. hispida* and *K. robusta* needs to be reviewed comprehensively, based on morphology (generative characters) or molecular.

The study showed that *K. echinometra* could easily be distinguished from other species in the genus *Korthalsia*. The species with the highest percentage coefficient similarity (0.93) are *K. hispida* and *K. robusta*.

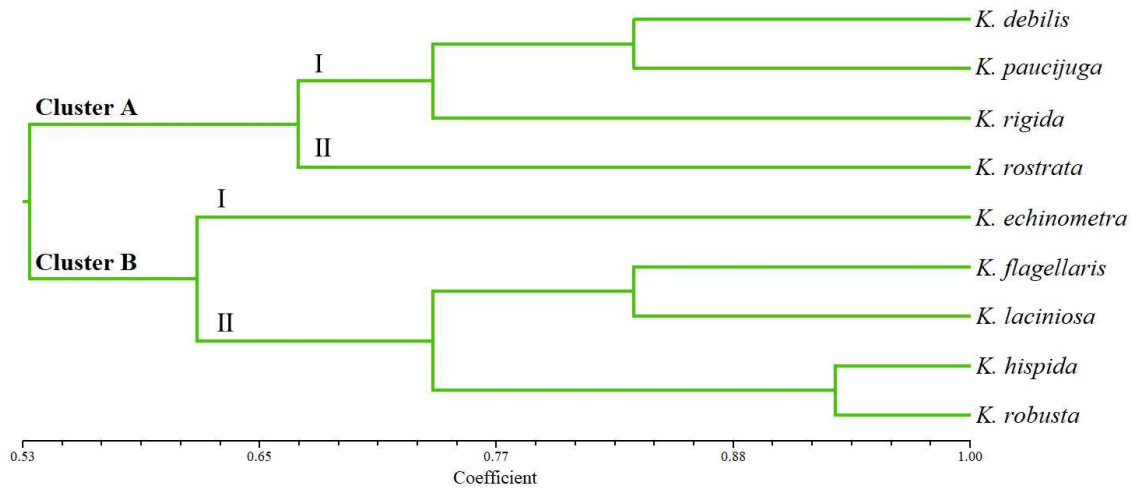
The study also showed that *Korthalsia* had varied morphological characters that were distinguishable in

each species. Some species were indistinguishable in some conditions, *i.e.* *K. debilis*, *K. paucijuga*, and *K. rigida*. Dransfield (1980) explained that *K. debilis* and *K. rigida* were undistinguishable if observed from vegetative characters. In this study, almost all of the specimens from *K. debilis*, *K. paucijuga*, and *K. rigida* were sterile. *Korthalsia* had a unique character that could distinguish it from another genus in *Calamoideae*. *Korthalsia* does not have knees and has rhomboid-shaped leaflets. Furthermore, generative characters may be crucial to identifying species rather than vegetative characters, but in some species, the characters can distinguish from the vegetative ones.

*Korthalsia* was generally found at 3 - 1300 m altitude. Generally, rattan is found in tropical areas at an altitude up to 3000 m above sea level with soil or rock substrates, except in mangrove forest areas (Dransfield et al., 2002). Certain

types were found in several numbers in peatland forest areas or swamps. The types of *Korthalsia* found in peat or swamp forest areas included *K. flagellaris* and *K. paucijuga*. These findings supported previous research conducted by Dransfield (1980), who stated that this type grew in their habitat with peat or swampland conditions.

*Korthalsia* was more common in lowland forest and dipterocarp forest habitats than other habitats. It was also following the research conducted by Watanabe & Suzuki (2008), who discovered that *Korthalsia* rarely grew in conditions, such as swamps or peat. Few types of a rattan could live in inundated soil conditions where the amount of water is stagnant and very little, compared to forest habitat dipterocarp (Dransfield, 1992). This is because the conditions could complicate and inhibit drainage in plants and inhibit the growth of the seedlings underneath (Siebert, 1993).



**Figure 4.** A UPGMA diagram of *Korthalsia* spp. in Sumatra based on morphological characters

#### 4. Conclusion and Recommendation

##### 4.1. Conclusion

There were nine species of *Korthalsia* in Sumatra found in the analysis of its morphological characters. Each species was distinguishable based on

the shape and size variations of *Korthalsia* in Sumatra. The key morphological characters distinguishable among the species included ocrea type, leaflets shape, and inflorescences. The phenogram showed *Korthalsia* formed

two main clusters, *i.e.*, Cluster A consisting of 4 species and Cluster B consisting of five species. The similarity of *Korthalsia* in Sumatra showed that *K. echinometra* had a coefficient similarity of 0.61. The closest similarity was found between *K. hispida* and *K. robusta* with a coefficient similarity of 0.93. The distribution study of *Korthalsia* showed that *Korthalsia* was distributed in Sumatra with some variations of the total species in each region. South Sumatra contained the richest species number of *Korthalsia* with 6 out of 9 species in Sumatra.

#### 4.2. Recommendation

Further research needs to be done for *Korthalsia* in other phytogeographic regions in Indonesia or Malesia. This study can be a reference for taxonomic researchers, and it can be the newest taxonomic status of *Korthalsia* in Sumatra. This study contained identification keys and descriptions of the species of *Korthalsia* in Sumatra that can be used to facilitate the identification of other species of *Korthalsia*. This study can be used as basic information to introduce the species of *Korthalsia* to maintain the population in the natural habitat.

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