

## Volume 6, Issue 1, April 2021



Published by:

Faculty of Biology  
Universitas Gadjah Mada

In collaboration with:



## **DAFTAR ISI**

1. *Cover* jurnal
2. Halaman pengesahan
3. Artikel final yang sudah dipublikasi
4. Detail jurnal
5. Editor Decision - Submit
6. Editor Decision - Revisi
7. Editor Desicion - Short Communication
8. Acceptance Letter Artikel
9. Proofread Layout

**2.**

**Halaman Pengesahan**

## HALAMAN PENGESAHAN

Judul : Identification of *Dendrobium* (Orchidaceae) in Liwa Botanical Garden  
Based on Leaf Morphological Characters

Penulis : **Mahfut**, Tundjung Tripeni Handayani, Sri Wahyuningsih, Sukimin  
NIP : 198109092014041001

Instansi : Jurusan Biologi, Fakultas MIPA, Universitas Lampung

Publikasi : Journal of Tropical Biodiversity and Biotechnology, Vol. 6, No.1, pp.  
1-6, 2021

Alamat Web (Link) : <https://doi.org/10.22146/jtbb.59423>  
<http://repository.lppm.unila.ac.id/id/eprint/43093>

Penerbit : Faculty of Biology, Gadjah Mada University

ISSN : 2540-9581 (eISSN)

Indeks : Scopus Q4 (2021); SJR 2021 : 0.13

Jenis Publikasi : Jurnal Internasional Bereputasi

Bandar Lampung, 14 Juli 2022

Mengetahui,  
Dekan Fakultas MIPA



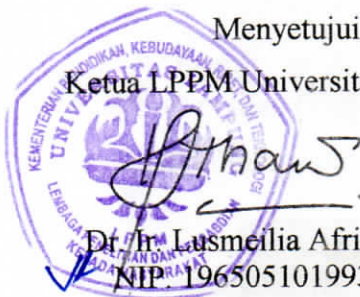
Dr. Eng. Satripto Dwi Yuwono, M.T.  
NIP. 197407052000031001

Penulis

Dr. Mahfut, M.Sc.  
NIP. 198109092014041001

Menyetujui,

Ketua LPPM Universitas Lampung



Dr. Ir. Lusmeilia Afriani, D.E.A  
NIP. 196505101993032008

DOKUMENTASI LEMBAGA PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT UNIVERSITAS LAMPUNG	
TGL	26/07/2022
NO. INVEN	555/S/le/1/FMIPA/2022
JENIS	Jurnal
PARAF	J

**3.**

**Artikel Final Yang  
Sudah Dipublikasi**

# Table of Contents

## Short Communications

- Biomass Estimation of Eaglewood (*Aquilaria filaria* (Oken) Merr.) in the Karst Ecosystem of West Papua jtbb59221  
*Andes Hamuraby Rozak, Zaenal Mutaqien, Destri*
- Antibacterial Activity of *Kecombrang* Flower (*Etilingera elatior* (Jack) R.M. Sm) Extract against Staphylococcus *epidermidis* and Propionibacterium *acnes* jtbb58528  
*Vilya Syafriana, Renita Noviani Purba, Yayah Siti Djuhariah*
- Seed and Germination Study of a New Guinea Endemic Plant Species *Grevillea papuana* Diels jtbb61115  
*Farid Kuswantoro*
- Identification of *Dendrobium* (Orchidaceae) in Liwa Botanical Garden Based on Leaf Morphological Characters jtbb59423  
*Mahfut, Tundjung Tripeni Handayani, Sri Wahyuningsih, Sukimin*

## Research Articles

- Screening and Identification of Mushrooms Growth Promoting Bacteria on Straw Mushrooms (*Volvariella volvacea*) jtbb60618  
*Indah Juvita Sari, I Nyoman Pugeg Aryantha*
- Antifungal Activity of Bacterial Isolates from Straw Mushroom Cultivation Medium against Phytopathogenic Fungi jtbb59235  
*Masrukhin, Ade Lia Putri, Tri Ratna Sulistiyani, Muhammad Ilyas, Ismu Purnaningsih, IwanSaskiawan, Muhammad Yusrun Niam*
- Update on New Species and Record of Fishes in the Coral Triangle Region for the Last 10 Years (2008-2019) jtbb59230  
*Fione Yukita Yalindua, Teguh Peristiwady, Putri Saphira Ibrahim*
- Avifaunal Diversity and Community Structure in Universitas Brawijaya Forest, East Java, Indonesia jtbb58335  
*Agus Nurrofik, Muhammad Fathoni, Agung Sib Kurnianto, Lubur Septiadi, Nia Kurniawan*
- Callus induction and secondary metabolite profile from *Elephantopus scaber* L. jtbb59234  
*Junairiah, Diah Ayu Wulandari, Edy Setiti Wida Utami, Nabilah Istighfari Zuraidassanaaz*
- The Use of DNA Barcoding and Phylogenetic Analysis to Improve Identification of *Usnea* spp. Based on ITS rDNA jtbb58635  
*Miftahul Jannah, Muhammad Rifqi Hariri, Rina Sri Kasiamdari, Niken Satuti Nur Handayani*
- The Abundance of Fish Species in Branched (*branching*) and Table (*tabulate*) Coral Habitat on Tanjung Beach, Muna Island, Southeast Sulawesi jtbb59481  
*Muhamad Tasyilan, Muhammad Sirih*
- Potential Screening of Bacteriocinogenic-Lactic Acid Bacteria from Mangrove Sediment of Logending Beach for Fisheries Product Preservation jtbb61927  
*Dyah Fitri Kusbaryati, Taruna Dwi Satwika, Afifah Mariana, Anwar Rovik*

Ethnobotanical and Phytochemical Study of Bayur (*Pterospermum javanicum* Jungb.) on Sasak Tribe around Mount Rinjani National Park, West Lombok as a Conservation Effort jtbb61008  
*Putri Sri Andila, Tri Warseno, I Putu Agus Hendra Wibawa, I Gede Tirta*

Predicting the Distribution of Sunda Pangolin (*Manis javanica* Desmarest, 1822) in Way Canguk Research Station, Bukit Barisan Selatan National Park, Lampung jtbb58612  
*Silvi Dwi Anasari, Wulan Pusparini, Noviar Andayani*

### **Review Article**

Nutrigenomic and Biomolecular Aspect of *Moringa oleifera* Leaf Powder as Supplementation for Stunting Children jtbb60113  
*Agus Indra Yudhistira Diva Putra, Nyoman Budhi Wirananda Setiawan, Made Indira Dianti Sanjiwani, Ida Ayu Ika Wahyuniari, Agung Wiviek Indrayani*<sup>3</sup>

## Identification of *Dendrobium* (Orchidaceae) in Liwa Botanical Garden Based on Leaf Morphological Characters

<https://doi.org/10.22146/jtbb.59423>

Mahfut Mahfut<sup>(1\*)</sup>, Tundjung Tripeni Handayani<sup>(2)</sup>, Sri Wahyuningsih<sup>(3)</sup>, Sukimin Sukimin<sup>(4)</sup>

(1) Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung

(2) Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung

(3) Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung

(4) Liwa Botanical Garden

(\*) Corresponding Author

### Abstract

Orchid is one of the most popular ornamental plants in the world. One of the orchid genera that is collected in a large number and known to have high morphological variations in the Liwa Botanical Garden is *Dendrobium*. However, to date, many *Dendrobium* collections have not been identified. Given the urgency of identification and the limitations of specimens in the field, especially flower organs, this study is important. This study aims to determine variations in morphological characters, phenetic relationships, and to identify *Dendrobium* collections based on leaf morphological characters in the Liwa Botanical Garden. Five accessions of *Dendrobium* were collected, namely CAT140, CAT 144, CAT 271, CAT 274, and IR015. Observation of 11 morphological characters leaves showed that leaf had high variations. The phenetic relationship based on the Gower similarity value and the UPGMA method shows that the *Dendrobium* in the Liwa Botanical Garden can be classified into 2 main groups formed with a similarity index value of 0.813. Based on Principle Component analysis values, it is known that the characters that have a large influence on grouping are the ratio of leaf length and width, leaf cross section, and leaf arrangement. The phenetic dendrogram topology is supported by the morphological character classification. The results of this study are expected to be basic information in the identification of natural orchids and conservation efforts in the Liwa Botanical Garden.

### Keywords

orchid; morphological leaf; identification; *Dendrobium*; UPGMA; Liwa Botanical Garden

### Full Text:



### References

- Adi, MC. et al., 2019. Buku Saku Kebun Raya Liwa. Badan Penelitian dan Pengembangan Kabupaten Lampung Barat. UPTD Pengelola Kebun Raya Liwa, 41.
- Darmawati, IAP. et al., 2018. The Diversity of Wild *Dendrobium* (Orchidaceae) in Central Bali, Indonesia. *Biodiversitas*, 19(3), pp.1110-1116.
- De, LC. et al., 2015. Morphological Characterization In *Dendrobium* Species. *Journal of Global Biosciences*, 4(1), pp.1198-1215.
- Dressler, RL., 1993. *Phylogeny and Clasification of The Orchid Family*. Dioscorides Press, Porland, Oregon, 314.
- Hartati, S. & Darsana, L., 2015. Karakterisasi Angrek Alam secara Morfologi dalam Rangka Pelestarian Plasma Nutfah. *Jurnal Agronomi Indonesia*. 43(2), pp.133-139.
- Indraloka, AB. et al., 2019. Morphological Characteristics And Pollinia Observation of 10 Indonesia Native *Dendrobium* Orchids. *Biovalentia*, 5(2), pp.38-45.
- Kartikaningrum, S. et al., 2004. *Panduan Karakterisasi Tanaman Hias: Angrek dan Anthurium*. Badan Penelitian Dan Pengembangan Pertanian Komisi Nasional Plasma Nutfah, 35.
- Kumalawati, AD. et al., 2011. Study on Genetic Diversity and Conservation of Orchids in Wonosadi Forest, Gunung Kidul Based on Molecular Analysis. *International Conference on Biological Science*, 54.
- Mahfut et al., 2019. *Konservasi Angrek Alam di Kebun Raya Liwa*. Laporan Hasil Penelitian Universitas Lampung, 15.
- Pang, S. et al., 2012. Floral morphology and reproductive biology of *Dendrobium jiajiangense* (Orchidaceae) in Mt. Fotang, Southwestern China. *Flora-Morphology, Distribution, Functional Ecology of Plants*, 207(6), pp.469-474.
- Solihah, SM., 2015. Koleksi, Status, dan Potensi Angrek di Kebun Raya Liwa. *Warta Kebun Raya*. 13(1), pp.14-23.
- Yuan, Y. et al., 2020. The major factors influencing distribution of three species of *Dendrobium*: Analysis of potential ecologically suitable

Editorial Team

Focus & Scope

Submissions

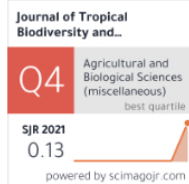
Author Guidelines

Author Fees

Publication Ethics

Screening For Plagiarism

### JOURNAL RANK



### TEMPLATE



### WRITING TOOLS



### USER

You are logged in as...

**mahfut**

▶ My Journals

▶ My Profile

▶ Log Out

### JOURNAL CONTENT

Search

Search Scope



Browse

▶ By Issue

▶ By Author

▶ By Title



## Short Communication

# Identification of *Dendrobium* (Orchidaceae) in Liwa Botanical Garden Based on Leaf Morphological Characters

Mahfut<sup>1\*</sup>, Tundjung Tripeni Handayani<sup>1</sup>, Sri Wahyuningsih<sup>1</sup>, Sukimin<sup>2</sup>

1) Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung, Jl. Sumantri Brojonegoro No 1, Bandar Lampung, Indonesia. 35141.

2) Liwa Botanical Garden. Way Mengaku, Balik Bukit, Lampung Barat, Lampung, Indonesia. 34814

\* Corresponding author, email: mahfut.mipa@fmipa.unila.ac.id

Submitted: 03 September 2020; Accepted: 09 February 2021; Published online: 02 March 2021

### ABSTRACT

Orchid is one of the most popular ornamental plants in the world. One of the orchid genera that is collected in a large number and known to have high morphological variations in the Liwa Botanical Garden is *Dendrobium*. However, to date, many *Dendrobium* collections have not been identified. Given the urgency of identification and the limitations of specimens in the field, especially flower organs, this study is important. This study aims to determine variations in morphological characters, phenetic relationships, and to identify *Dendrobium* collections based on leaf morphological characters in the Liwa Botanical Garden. Five accessions of *Dendrobium* were collected, namely CAT140, CAT 144, CAT 271, CAT 274, and IR015. Observation of 11 morphological characters leaves showed that leaf had high variations. The phenetic relationship based on the Gower similarity value and the UPGMA method shows that the *Dendrobium* in the Liwa Botanical Garden can be classified into 2 main groups formed with a similarity index value of 0.813. Based on Principle Component analysis values, it is known that the characters that have a large influence on grouping are the ratio of leaf length and width, leaf cross section, and leaf arrangement. The phenetic dendrogram topology is supported by the morphological character classification. The results of this study are expected to be basic information in the identification of natural orchids and conservation efforts in the Liwa Botanical Garden.

**Keywords:** orchid, morphological leaf, identification, *Dendrobium*, UPGMA, Liwa Botanical Garden

Orchidaceae (orchids) is one of the biggest plant families that consist of approximately 25,000 species belongs to over 900 genera across the world. Orchids have high variations in the morphology of the flowers, leaves, and stems (pseudobulbs). *Dendrobium* is one of the orchid genera containing a large number of species (approximately 1500 species) widely spread across the world, from Japan, China, India, the Malacca Peninsula, Indonesia, the island of Papua, to Australia. This orchid has a charming flower ([Dressler 1993](#); [Kartikaningrum et al. 2004](#); [Kumalawati et al. 2011](#); [Hartati & Darsana 2015](#)).

*Dendrobium* comes from the words "dendro" (tree) and "bios" (life). *Dendrobium* means orchids that grow on a living tree. *Dendrobium* has various shapes, sizes, and colors of flowers. Flowers that have bloomed can last in

one day to more than 30 days and each stem can have one to more than 20 flowers. Many *Dendrobium* grows at locations with an altitude less than 400 meters above sea level ([Pang et al. 2012](#); [De et al. 2015](#); [Darmawati et al. 2018](#); [Indraloka et al. 2019](#); [Zahara & Win 2019](#); [Yuan et al. 2020](#)).

The Liwa Botanical Garden located in West Lampung Regency (Lampung, Sumatra island) is an institution that performs ex situ conservation of plants including orchids. Orchids have been given high priority in conservation because many orchids are threatened in the wild because of exploitation and overcollection for economic reasons that lead to the population decline and disappearance of many orchid species. Another threatening factor is deforestation causing the loss and damage of orchids, a natural habitat that will lead to the extinction of orchids. Liwa Botanical Garden has an important role in the preservation and conservation of plants including orchids. Many orchid species have been collected from the natural habitats for conservation purposes in the Liwa Botanical Gardens. However, many orchid species have not yet been identified in these gardens ([Solihah 2015](#); [Adi et al. 2019](#); [Mahfut et al. 2019](#)).

Identification of orchid species is important in orchid conservation. The present study focussed on the identification of some specimens of *Dendrobium* (one of the largest orchid genera) that will be based on the morphological characters as one of the important tools in the plant's taxonomic and systemic basis. The morphological characters that will be used in the present study are leaf morphology. Given the urgency of identification and the limitations of specimens in the field, especially flower organs, this study is important. This study aims to determine variations in morphological characters and phenetic relationships for the identification of *Dendrobium* in the Liwa Botanical Garden. The results of this study are expected to serve as basic information in the identification of natural orchids to support conservation in the Liwa Botanical Garden.

### Sample collection

Sample collections that were identified based on leaf morphological characters included 5 accessions with sample codes CAT140, CAT 144, CAT 271, CAT 274, and IR015 (Table 1). *Dendrobium* samples were chosen based on orchid data that had not yet been identified. Overall, the sample accessions are native orchids to Lampung.

**Table 1.** List of accessions of *Dendrobium* samples in the Liwa Botanical Garden.

No. Acc.	Species	Origin Location
CAT140	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT144	<i>Dendrobium</i> sp.	Seminung Forest
CAT271	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT274	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
IR015	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park

### The morphological identification






The morphological identification was performed by direct observation to the leaf morphology characters including leaf shape, length (L) and width (W) tip shape, cross section, arrangement, edge shape, surface texture, symmetry, and arrangement ([Dressler 1993](#); [Kartikaningrum et al. 2004](#); [Hartati & Darsana 2015](#)).

Based on observations of morphological characters, orchid plants have a high variation. These variations were found in habitus, pseudobulb, leaves, and flowers ([Dressler 1993](#); [Kartikaningrum et al. 2004](#); [Hartati & Darsana](#)

2015). In this research characterization of the flower was not performed because limited specimens were obtained in the field and had not flowered yet.

Based on observations, *Dendrobium* leaves are known as the most varied organs (Table 2). Variations in leaf characters included leaf shape (S), length (L), width (W), tip shape, cross section, arrangement, edge shape, surface texture, and symmetry. Overall, the accession of *Dendrobium* samples at the Liwa Botanical Garden showed different morphological characters of the leaves, namely the cross-section. The leaf cross section of samples with accession numbers CAT 274, CAT 140, and IR 015 are semi terete, whereas that of a sample with accession number CAT 144 is terate and CAT 271 is flat. In addition, leaf arrangement was found in all samples are alternate.

**Table 2.** Leaf Type of Accession of *Dendrobium* samples in the Liwa Botanical Garden. Bar = 1 cm.

No. Acc	Leaf Shape
CAT140	
CAT144	
CAT271	
CAT274	
IR015	

The ratio difference between leaf length and width between the five accessions show that the shapes of the leaves of the five accessions are different. The complete identification of the morphology of the leaves of the *Dendrobium* accession sample at the Liwa Botanical Garden is presented in Table 3.

**Table 3.** Variation of morphological characters of the accession of *Dendrobium* samples in the Liwa Botanical Garden.

Morphology Character	CAT 274	CAT 144	CAT 140	IR 015	CAT 271
Leaf Shape (S)	Ovate	Triangular	Oblong	Lanceolate	Linear
Length (L) and width (W) of leaf	L: 4,5 cm W: 1 cm	L: ±1,7 cm W: 0,5 cm	L: 9,5 cm W: 1,5 cm	L: 8 cm W: 2 cm	L: 8,5 cm W: 1,5 cm
Leaf Tip	Obtuse	Acuminate	Obtuse	Acute	Acuminate
Leaf Cross Section	Semi terete	Terete	Semi terete	Semi terete	Flat
Arrangement of Leaves	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf Edge	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)
Leaf Surface Texture	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)
Leaf Symmetry	Symmetry	Symmetry	Symmetry	Symmetry	Symmetry

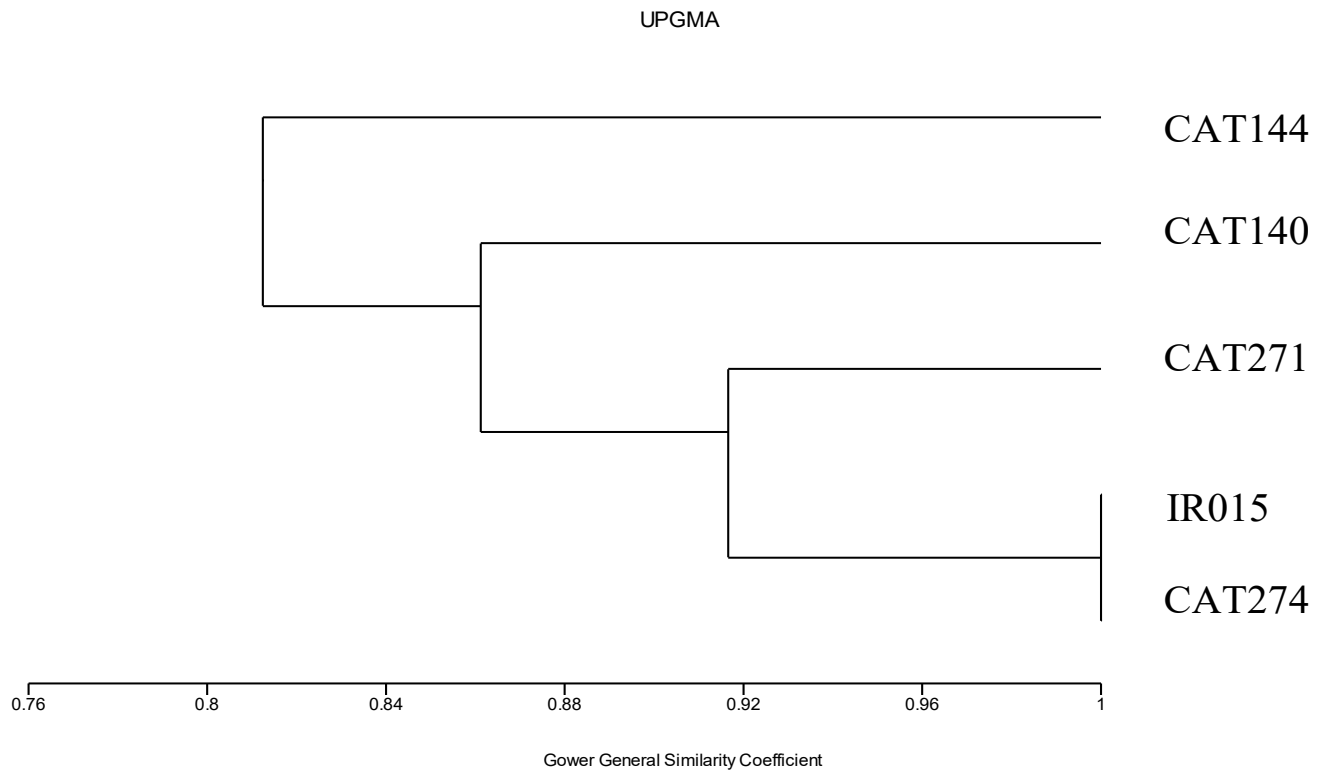
Based on Table 3, it is known that most of the accessions of *Dendrobium* samples in the Liwa Botanical Garden showed different morphological characters in the leaves.

### Phenetic Analysis

The Phenetic analysis is performed through cluster analysis methods and Principal Component Analysis (PCA). Cluster analysis begins with the morphological character scoring, then the Gower (Gower's General Similarity) similarity value is calculated which results in a matrix of similarity between accessions. Data matrix similarity is done by agglomerative hierarchical clustering using the UPGMA method and displayed in the form of a dendrogram.

Phenetic analysis on *Dendrobium* is performed through 2 methods, namely cluster analysis, and PCA. Cluster analysis begins with the morphological character scoring, then the Gower (Gower's General Similarity) similarity value is calculated which results in a matrix of similarities between accessions. Then the similarity matrix data is done by agglomerative hierarchical clustering using the UPGMA method. The results of cluster analysis of 5 *Dendrobium* accessions based on the characters produced by the dendrogram are presented in Figure 1.

Grouping the sample based on the level of similarity between accessions calculated using the gower coefficient formula and UPGMA was chosen for the clustering technique to produce a dendrogram showing 2 main groups formed with a similarity index value of 0.813 marked as group A and group B. Group A consists of CAT 144 which has a distinguishing character that distinguishes from group B, namely the cross section of the double leaf character (Figure CAT 144). Group B consists of CAT 140, CAT 271, IR 015, and CAT 274 which have symmetrical cross-section characters (Figure CAT 140, CAT 271, IR 015, and CAT 274). Group B is divided into 2 sub-groups with a similarity index value of 0.861 marked with B1 and B2



**Figure 1.** Dendrogram of 5 accessions *Dendrobium* samples from the Liwa Botanical Garden using UPGMA.

on the dendrogram. Characters that show the difference on ratio of the length and width of the leaf and leaf arrangement are same in all samples. Subgroup B1 consists of CAT 140, while subgroup B2 consists of CAT 271, IR 015, and CAT 274. B2 subgroups are divided into 2 namely B2a and B2b based on differences in leaf length and width ratios. The grouping of IR 015 and CAT 274 in one B2b group with a similarity level of 100% indicates that they are the same type. Based on the PCA values, it can be seen that the characters that have a large influence on grouping are the ratio of leaf length and width (PLD), leaf cross section (PMD), and leaf arrangement (DKD).

### AUTHOR CONTRIBUTION

M is the main researcher who conceptualized and collected data. He did data analysis and interpretation and drafted and finalized this manuscript. S is the supervisor at Liwa Botanical Garden, he is with TTH and SW are provided the guidance from conceptualization of the research objectives, methodology, data collection, analysis, and interpretation of the results. All were key in the development, drafting later on and finalizing of this manuscript.

### ACKNOWLEDGMENTS

This research was funded by Lembaga Penelitian dan Pengabdian Masyarakat (LPPM), Universitas Lampung through the DIPA BLU 2020 Grant with contract number 1492 / UN26.21 / PN / 2020. Thank you to Liwa Botanical Garden who facilitated the research. This activity is a continuation of the collaboration program with Department of Biology, Faculty of Mathematics and Natural Science, Universitas Lampung.

### CONFLICT OF INTEREST

The authors report no conflicts of interest regarding the research or the research funding.

## REFERENCES

- Adi, MC. et al., 2019. Buku Saku Kebun Raya Liwa. Badan Penelitian dan Pengembangan Kabupaten Lampung Barat. *UPTD Pengelola Kebun Raya Liwa*, 41.
- Darmawati, IAP. et al., 2018. The Diversity of Wild Dendrobium (Orchidaceae) in Central Bali, Indonesia. *Biodiversitas*, 19(3), pp.1110-1116.
- De, LC. et al., 2015. Morphological Characterization In Dendrobium Species. *Journal of Global Biosciences*, 4(1), pp.1198-1215.
- Dressler, RL., 1993. Phylogeny and Clasification of The Orchid Family. *Dioscorides Press, Porland, Oregon*, 314.
- Hartati, S. & Darsana, L., 2015. Karakterisasi Anggrek Alam secara Morfologi dalam Rangka Pelestarian Plasma Nutfah. *Jurnal Agronomi Indonesia*. 43(2), pp.133-139.
- Indraloka, AB. et al., 2019. Morphological Characteristics And Pollinia Observation of 10 Indonesia Native Dendrobium Orchids. *Biovalentia*, 5(2), pp.38-45.
- Kartikaningrum, S. et al., 2004. Panduan Karakterisasi Tanaman Hias: Anggrek dan Anthurium. *Badan Penelitian Dan Pengembangan Pertanian Komisi Nasional Plasma Nutfah*, 35.
- Kumalawati, AD. et al., 2011. Study on Genetic Diversity and Conservation of Orchids in Wonosadi Forest, Gunung Kidul Based on Molecular Analysis. *International Conference on Biological Science*, 54.
- Mahfut et al., 2019. Konservasi Anggrek Alam di Kebun Raya Liwa. *Laporan Hasil Penelitian Universitas Lampung*, 15.
- Pang, S. et al., 2012. Floral morphology and reproductive biology of Dendrobium jiajiangense (Orchidaceae) in Mt. Fotang, Southwestern China. *Flora-Morphology, Distribution, Functional Ecology of Plants*, 207(6), pp.469-474.
- Solihah, SM., 2015. Koleksi, Status, dan Potensi Anggrek di Kebun Raya Liwa. *Warta Kebun Raya*. 13(1), pp.14-23.
- Yuan, Y. et al., 2020. The major factors influencing distribution of three species of Dendrobium: Analysis of potential ecologically suitable distributions. *Journal of Applied Research on Medicinal and Aromatic Plants*. 19, pp.100275.
- Zahara, M. & Win, CC. 2019. Morphological and Stomatal Characteristics of Two Indonesian Local Orchids. *Journal of Tropical Horticulture*. 2(2), pp.65-69.

**4.**

# **Detail Jurnal**

# Source details

[Feedback >](#) [Compare sources >](#)

## Journal of Tropical Biodiversity and Biotechnology

Open Access

Scopus coverage years: from 2020 to Present

Publisher: Universitas Gadjah Mada, Faculty of Biology

ISSN: 2540-9573 E-ISSN: 2540-9581

Subject area: [Agricultural and Biological Sciences: Agricultural and Biological Sciences \(miscellaneous\)](#)

[Immunology and Microbiology: Applied Microbiology and Biotechnology](#) [View all v](#)

Source type: Journal

[View all documents >](#) [Set document alert](#) [Save to source list](#) [Source Homepage](#)

CiteScore 2021   
**0.2**

SJR 2021   
**0.125**

SNIP 2021   
**0.462**

[CiteScore](#) [CiteScore rank & trend](#) [Scopus content coverage](#)

**Improved CiteScore methodology** x

CiteScore 2021 counts the citations received in 2018-2021 to articles, reviews, conference papers, book chapters and data papers published in 2018-2021, and divides this by the number of publications published in 2018-2021. [Learn more >](#)

CiteScore **2021**

$$0.2 = \frac{17 \text{ Citations 2018 - 2021}}{74 \text{ Documents 2018 - 2021}}$$

Calculated on 05 May, 2022

CiteScoreTracker **2022**

$$0.5 = \frac{51 \text{ Citations to date}}{112 \text{ Documents to date}}$$

Last updated on 05 November, 2022 • Updated monthly

### CiteScore rank 2021

Category	Rank	Percentile
Agricultural and Biological Sciences	#110/119	7th
Agricultural and Biological Sciences (miscellaneous)		
Immunology and Microbiology	#110/118	7th
Applied Microbiology and Biotechnology		

[View CiteScore methodology >](#) [CiteScore FAQ >](#) [Add CiteScore to your site](#)

### About Scopus

- [What is Scopus](#)
- [Content coverage](#)
- [Scopus blog](#)
- [Scopus API](#)
- [Privacy matters](#)

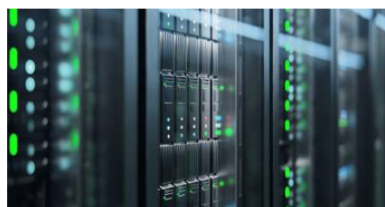
### Language

- [日本語版を表示する](#)
- [查看简体中文版本](#)
- [查看繁體中文版本](#)
- [Просмотр версии на русском языке](#)

### Customer Service

- [Help](#)
- [Tutorials](#)
- [Contact us](#)





## Scientific Programming Papers

Open

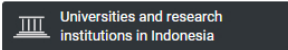


Hindawi

## Journal of Tropical Biodiversity and Biotechnology

COUNTRY

Indonesia



SUBJECT AREA AND CATEGORY

- Agricultural and Biological Sciences
  - Agricultural and Biological Sciences (miscellaneous)
  - Ecology, Evolution, Behavior and Systematics
- Biochemistry, Genetics and Molecular Biology
  - Biotechnology
- Immunology and Microbiology
  - Applied Microbiology and Biotechnology

PUBLISHER

Universitas Gadjah Mada, Faculty of Biology

H-INDEX

2

PUBLICATION TYPE

Journals

ISSN

25409573, 25409581

COVERAGE

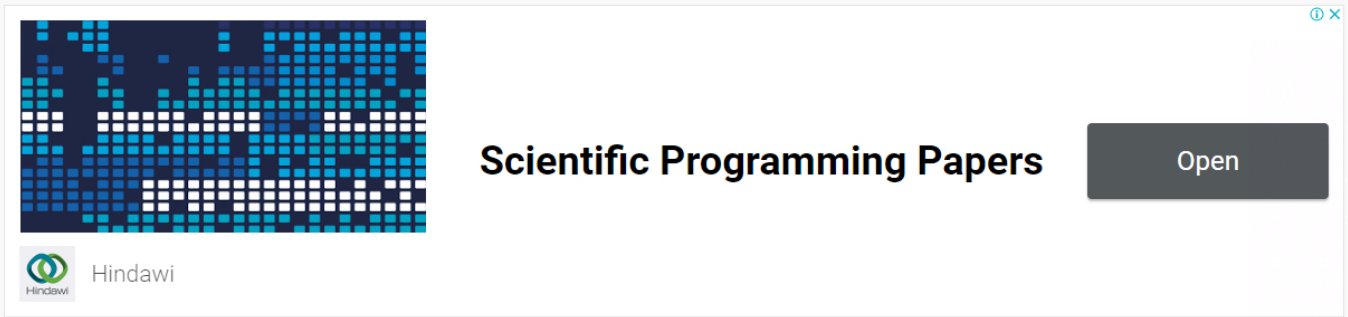
2020-2021

**Scientific Programming Papers**

Maximize the Impact, Reach & Visibility of Your Next Paper by Publishing With Us



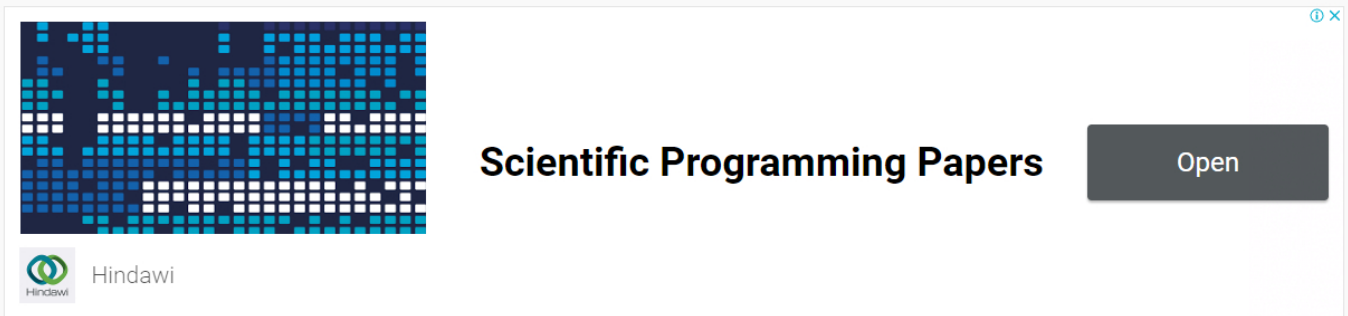
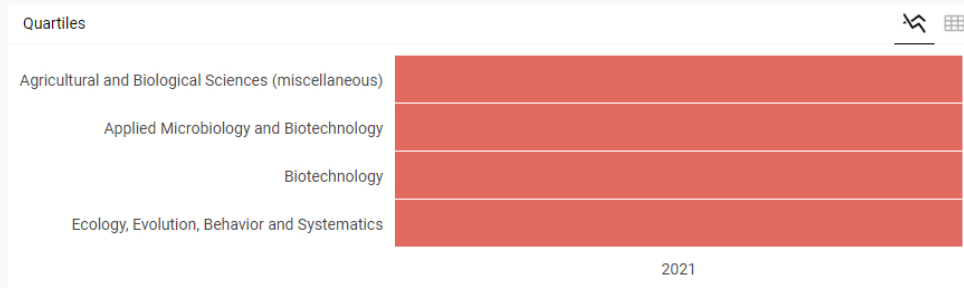
Hindawi



## Scientific Programming Papers

Open

Hindawi

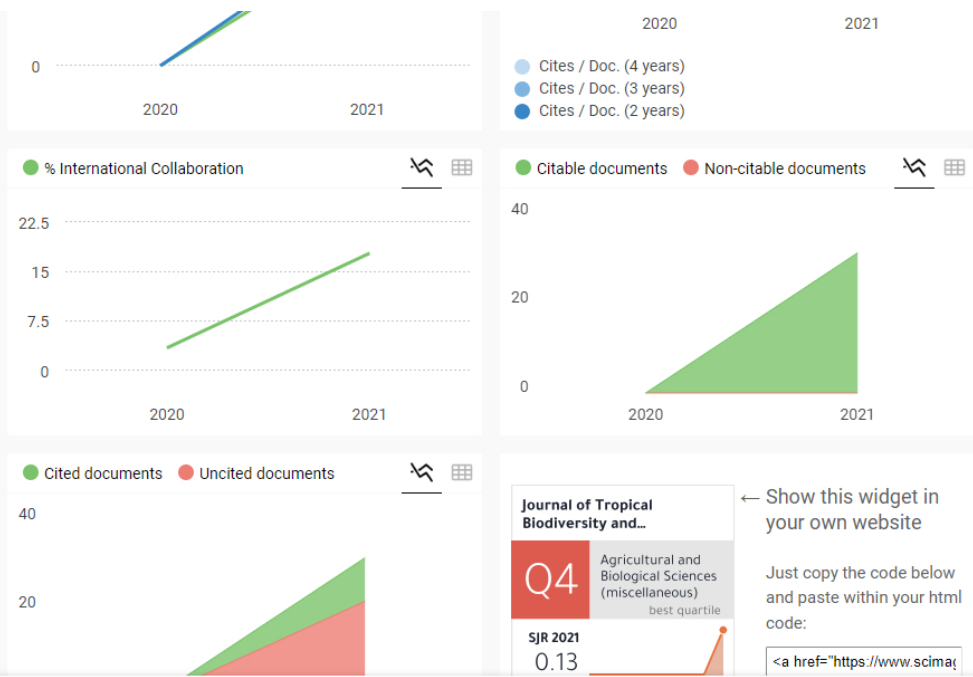


## Scientific Programming Papers

Open

Hindawi





Journal of Tropical Biodiversity and...

Q4 Agricultural and Biological Sciences (miscellaneous) best quartile

SJR 2021 0.13

Show this widget in your own website

Just copy the code below and paste within your html code:

```
<a href="https://www.scimag
```

Explore, visually communicate and make sense of data with our [new data visualization tool](#).

**Scientific Programming Papers**

Open

Hindawi

Metrics based on Scopus® data as of April 2022

**W** what the level international journal Journal of Tropical Biodiversity and Biotechnology

4 months ago

i cant to see level of journal

reply

**Melanie Ortiz** 3 months ago

Dear Sir/Madam,

Thank you for contacting us. Could you please expand a little bit on your comment?

**5.**

**Editor Decision -  
Submit**

Compose

Back, Reply, Reply All, Forward

Archive, Move, Delete, Spam, More

Yahoo/Inbox

Settings

- Inbox (281)
- Unread
- Starred
- Drafts
- Sent
- Archive
- Spam
- Trash
- Less
- Views Hide
- Photos
- Documents
- Subscriptions
- Shopping
- Receipts
- Travel
- Folders Hide
- + New Folder



**Sri Nopitasari** <sri.nopitasari2809@gmail.com>  
 To: Mahfut Mahfut Mahfut  
 Cc: Mahfut Mahfut, Tundjung Tripeni Handayani, Sri Wahyuningsih, Sukimin Sukimin

Tue, Oct 27, 2020 at 5:37 PM

Dear Dr. Mahfut,

Thank you for submitting your work, titled "Identification of Dendrobium in the Liwa Botanical Garden Based on Morphological Characters", to Journal of Tropical Biodiversity and Biotechnology. After reviewing your submission, we will consider publishing your manuscript.

However, before we can proceed to publish the manuscript, we invite you to respond to the reviewers' comments and revise your manuscript carefully. Please highlight the changes you make by using the track changes mode in MS Word or by using bold or coloured text. We enclosed the reviewer comments for you to learn.

Please send us answers to the reviewers' comments in a separated file.

We expect to receive your revision within one week (November 4, 2020). If you fail to turn your revision in within the designated time, we may have to decline your manuscript without notification.

If you have any questions, please feel free to contact us.

Sincerely yours,  
 Sri Nopitasari  
 Journal of Tropical Biodiversity and Biotechnology  
[sri.nopitasari2809@gmail.com](mailto:sri.nopitasari2809@gmail.com)

Reviewer A:

It is better to add data on phenetics based on flowers and flower organs. Given that Dendrobium is relatively easier to be induced to flowering than other orchids. If data on flower phenetics can be added, this manuscript can be considered for acceptance for publication in JTBB.

Reviewer B:

- Methods in the morphological characterisation of the five accessions in this study are weak and need to be improved and completed. Please refer to some references for standardised methods: (i) Balai Penelitian Tanaman Hias. 2007. Panduan Karakterisasi Tanaman Hias Anggrek. Pusat Penelitian dan Pengembangan Hortikultura, Badan Penelitian dan Pengembangan Departemen Pertanian, Jakarta (ii) Hartati S, Darsana L. 2015. Karakterisasi Anggrek Alam secara Morfologi dalam Rangka Pelestarian Plasma Nutfah. J. Agron. Indonesia 43 (2) : 133 – 139 (it can be downloaded from the internet)
- The methods in this study on the morphological characterisation is incomplete and much focussed on the morphological characterisation of orchid leaves and had not include the characterisation of the morphology of flowers which is the strongest character and the most important character in the identification of orchid species. The standard methods in the morphological characterisation of orchids are based on the characterisation of flowers, leaves, stems (pseudobulbs), and roots.
- The character which is uncommon in morphological characterisation, such as plant height is used in this study. Better to not use the character of plant height and please refer to the standardised methods in morphological characterisation as mentioned above
- The terms used in the characterisation of orchids in this study are not really understandable and it is suggested to use standardised botanical and biological terms. To find the standardised botanical terms, Please refer to a book: Dressler RL. 1983. Phylogeny and classification of the orchid family. (it can be downloaded from the internet)
- The investigation in the morphological characterisation of the five orchid accessions of in this study is not clear and need to be validated and verified. For example, in the part of 'Results' it was stated that the shape of the five orchid accessions are the same, while it is definitely different. It is suggested to refer to the references for methods and standardised botanical terms mentioned above.
- Poor grammar in the article and needs to be improved
- This article lack references of morphological characterisation of orchids. Please use some references (other studies related to orchid morphological characterisation) as comparison with this study and for 'state of the art' about orchid morphological characterisation.

Journal of Tropical Biodiversity and Biotechnology  
<http://jtbb.or.id>  
 ISSN 2540-9573 (print)  
 ISSN 2540-9581 (online)



Reply, Reply All or Forward

Love it! Interesting. Thanks for sharing.

Send [Attachment icons]



**Sri Nopitasari**   
[sri.nopitasari2809@gmail.com](mailto:sri.nopitasari2809@gmail.com)  
 + Add to contacts

30 JAN - 03 FEB 2023

**Strategy for Health Care Delivery—Virtual**

Lead a value-based delivery organization for optimal performance. **GO.**

Harvard Business School Executive Education

**yahoo!mail**

**UNSUBSCRIBE IN A SINGLE TAB**

**6.**

**Editor Decision -  
Revisi**

Compose

Back

Archive

Move

Delete

Spam

More options

Calendar, Mailbox, etc.

Settings

- Inbox (281)
- Unread
- Starred
- Drafts
- Sent
- Archive
- Spam
- Trash
- Less
- Views Hide
- Photos
- Documents
- Subscriptions
- Shopping
- Receipts
- Travel

[JTBB] Editor Decision

Yahoo/Inbox



**Sri Nopitasari** <sri.nopitasari2809@gmail.com>  
 To: mahfut.mipa@fmipa.unila.ac.id, mahfutkariem@yahoo.com  
 Cc: tundjungtriprenihandayani@fmipa.unila.ac.id, wahyu6125@yahoo.co.id, sukimin81@gmail.com

Sun, Dec 27, 2020 at 10:23 PM

Dear Dr. Mahfut,

Thank you for submitting your work, titled "Identification of Dendrobium in the Liwa Botanical Garden Based on Morphological Characters", to Journal of Tropical Biodiversity and Biotechnology. After reviewing your submission, we will consider publishing your manuscript.

However, before we can proceed to publish the manuscript, we invite you to respond to the reviewers' comments and revise your manuscript carefully. Please highlight the changes you make by using the track changes mode in MS Word or by using bold or coloured text. We enclosed the reviewer comments for you to learn.

Please send us answers to the reviewers' comments in a separated file. Please use and follow the journal template 2021 (see the file).

We expect to receive your revision within one week (January 4, 2021). If you fail to turn your revision in within the designated time, we may have to decline your manuscript without notification.

If you have any questions, please feel free to contact us.

Sincerely yours,  
 Sri Nopitasari  
 Journal of Tropical Biodiversity and Biotechnology  
[sri.nopitasari2809@gmail.com](mailto:sri.nopitasari2809@gmail.com)

**Reviewer A:**  
 The manuscript entitled Identification of Dendrobium in the Liwa Botanical Garden based on Leaf morphological characters are important as it can support orchid conservation. The manuscript worths publication, however minor revision is required before publication (please see comments in the currently reviewed manuscript).

**Reviewer B:**  
 This manuscript shows that the easiest way to identify Dendrobium wild orchids in the forest / in their natural habitat is by leaf morphological characters. Although it is actually a bit difficult to accept, because what really distinguishes it is the character of the flowers. However, UPGMA data is sufficient to strengthen the interpretation that the leaf characters found have special characters that characterize each Dendrobium orchid.

The method of characterizing Dendrobium orchids based on simple leaf morphology in this text is quite interesting for people who want to get to know Dendrobium orchids. But more research is needed on the molecular characters that differentiate each Dendrobium species

Specific comments on the weaknesses of the article and what could be done to improve it. The genus Dendrobium is the orchid with the largest number of members, so that many species have similar leaf morphologies. Therefore, flower characters and data on molecular biology for the specific character of each plant is very important. In the future it can be analyzed in further research.

The manuscript still need some revisions (see the manuscript)  
The number of references used is too small amount, it needs to be added with new references on the classification of orchids published in the last 10 years.

Best Regards,  
 Sri Nopitasari, S.Si., M.Sc.  
 Faculty of Biology, Universitas Gadjah Mada  
 Jl. Teknika Selatan, Sekip Utara, Yogyakarta 55281, Indonesia  
 Mobile phone: +62-85310041481  
 e-mail: [sri.nopitasari2809@gmail.com](mailto:sri.nopitasari2809@gmail.com), [sri.nopitasari@mail.uogm.ac.id](mailto:sri.nopitasari@mail.uogm.ac.id)  
[Download all attachments as a zip file](#)

- article temp... .doc (115.5kB)
- 59423-1931... .doc (12MB)
- 59423-1835... .doc (12MB)

Navigation icons

Reply, Reply All or Forward

Thank you.    You are welcome.    Received, thank you.

Send    Attachments    Reply    Forward    Bold    Italic    Text color    Font size    More options

**Sri Nopitasari**

[sri.nopitasari2809@gmail.com](mailto:sri.nopitasari2809@gmail.com)  
 + Add to contacts

**yahoo! Homepage terlengkap**

Dapatkan kabar berita, olahraga, cuaca dan selebihnya hanya untuk anda.

**Unduh sekarang**

# 1 Identification of *Dendrobium* (*Orchidaceae*) in Liwa Botanical Garden Based on Leaf

## 2 Morphological Characters

### 4 Abstract

5 Orchid is [one of](#) the most popular ornamental plants in the world. One of the orchid genera  
6 [that is](#) collected [in a large number](#) and known to have high morphological variations in the  
7 Liwa Botanical Garden is *Dendrobium*. [However, to date](#) many *Dendrobium* collections have  
8 not been identified. [Given the urgency of identification and the limitations of specimens in](#)  
9 [the field, especially flower organs, this study is important.](#) This study aims to determine  
10 variations in morphological characters, phenetic relationships and [to identify](#) *Dendrobium*  
11 [collections](#) based on [leaf morphological characters](#) in the Liwa Botanical Garden. Five  
12 accessions of *Dendrobium* were collected, namely CAT140, CAT 144, CAT 271, CAT 274,  
13 and IR015. [Observation of 11 morphological characters leaves showed that leaf had high](#)  
14 variations. The phenetic relationship based on the Gower similarity value and the UPGMA  
15 method shows that the *Dendrobium* in the Liwa Botanical Garden can be classified into 2  
16 main groups formed with a similarity index value of 0.813. Based on Principle Component  
17 analysis values, it is known that the characters that have a large influence on grouping are the  
18 ratio of leaf length and width, leaf cross section, and leaf [arrangementsitting.](#) The [resulting](#)  
19 phenetic dendrogram topology is supported by the morphological character classification.  
20 The results of this study are expected to be basic information in the identification of natural  
21 orchids and conservation efforts in the Liwa Botanical Garden.

22  
23 Keywords: orchid, [morphological leaf](#), identification, *Dendrobium*, UPGMA, Liwa Botanical  
24 Garden

Formatted: Not Highlight



26

27

28

29

30

31

32

33

## 34 1. Introduction

35 [Orchidaceae \(orchids\)](#) is one [of the biggest plant families that](#) consist of  
36 [approximately 25,000](#) species [belong to](#) over 900 genera [across the world](#). Orchids have [high](#)  
37 variations in the morphology [of the flowers, leaves and stems](#) (pseudobulbs). [Dendrobium is](#)  
38 [one of orchid genera containing a large number of species \( approximately 1500 species\)](#)  
39 [widely spread across](#) the world, from Japan, China, India, the Malacca Peninsula, Indonesia,  
40 the island of Papua, to Australia. This orchid has a charming flower (Dressler, 1993;  
41 Kartikaningrum et al., 2004; Kumalawati et al., 2011; Hartati and Darsana, 2015).

42  
43 Dendrobium comes from the words "dendro" (tree) and "bios" (life). Dendrobium  
44 means orchids that grow on a living tree. Dendrobium [has various](#) shapes, sizes and colors of  
45 flowers. Flowers that have bloomed can last [in one day to](#) more than 30 days and each stem  
46 [can have one to](#) more than 20 flowers. [Many Dendrobium](#) grow at locations [with an altitude](#)  
47 less than 400 meters above sea level (Solihah, 2015; Mahfut et al., 2019).

48

49 The Liwa Botanical Garden [located in West Lampung Regency \(Lampung, Sumatra island\)](#)  
50 [is an institution that perform ex situ conservation of plants including orchids. Orchids have](#)

51 been given high priority in the conservation because many orchids are threatened in the wild  
52 because of exploitation and overcollection for economic reasons that lead to the population  
53 decline and disappearance of many orchid species. Another threatening factor is deforestation  
54 causing the loss and damage of orchids' natural habitat that will have consequences of  
55 orchids are becoming extinct. Liwa Botanical Garden have an important role for preservation  
56 and conservation of plants including orchids. Many orchid species have been collected from  
57 the natural habitats for conservation purposes in the Liwa Botanical Gardens. However,  
58 many orchid species have not yet been identified in this gardens (Solihah, 2015; Adi et al.,  
59 2019; Mahfut et al., 2019).

61 Identification of orchid species is important in the orchid conservation. The present  
62 study focussed on the identification of some specimens of *Dendrobium* (one of the largest  
63 orchid genera) that will be based on the morphological characters as one of important tools in  
64 the plant's taxonomic and systemic basis. The morphological characters that will be used in  
65 the present study are leaf morphology. Given the urgency of identification and the limitations  
66 of specimens in the field, especially flower organs, this study is important. This study aims to  
67 determine variations in morphological characters and phenetic relationships for identification  
68 of *Dendrobium* in the Liwa Botanical Garden. The results of this study are expected to serve  
69 as basic information in the identification of natural orchids to support conservation in the  
70 Liwa Botanical Garden.

## 72 **2. Materials and methods**

### 73 2.1. *Sample collection*

74 Leaves of *Dendrobium* accessions in the Liwa Botanical Garden that are native to  
75 Lampung were collected as samples. The sample collection was conducted in December 2019

76 - February 2020 at the orchid green house in the Liwa Botanical Garden. *Dendrobium*  
77 samples were chosen based on orchid data that had not yet been identified. All samples were  
78 tabulated and documented with photos.

## 81 2.2. The morphological identification

82 The morphological identification was performed by direct observation to the leaf  
83 morphology characters including leaf shape, length (P) and width (L), tip shape, cross  
84 section, arrangement, edge shape, surface texture, symmetry, and arrangement (Dressler,  
85 1993; Kartikaningrum et al., 2004; Hartati and Darsana, 2015).

**Comment [F1]:** Please check the abbreviation for length and width through all the manuscript. In this part length is abbreviated as P, while in Table 1 length is abbreviated as L. Similarly, in this part, width is abbreviated as L, while in Table 3 width is abbreviated as W. Please be consistent to use the same abbreviation. Better to use L for Length and W for Width through all the manuscript.

## 87 2.3. Phenetic analysis

88 Phenetic analysis is ~~done performed~~ through cluster analysis methods and Principal  
89 Component Analysis (PCA). Cluster analysis begins with the morphological character  
90 scoring, then the Gower (Gower's General Similarity) similarity value is calculated which  
91 results in a matrix of similarity between accessions. Data matrix similarity is done by  
92 agglomerative hierarchical clustering using the UPGMA method and displayed in the form of  
93 dendrogram.

## 95 3. Results and Discussion

### 96 3.1. Sample collection

97 ~~Sample cCollections results obtained that were identified based on leaf morphological~~  
98 ~~characters included~~ -5 accessions ~~of *Dendrobium* samples~~ with sample codes CAT140, CAT  
99 144, CAT 271, CAT 274, and IR015 (Table 1). Overall, the sample accessions are native  
100 orchids to Lampung.

101

102 **Table 14.** List of accessions of *Dendrobium* samples in the Liwa Botanical Garden

No. Acc.	Species	Origin Location
CAT140	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT144	<i>Dendrobium</i> sp.	Seminung Forest
CAT271	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT274	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
IR015	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park

103

104 3.2. The morphological identification

105 Based on observations of morphological characters, orchid plants have a high  
 106 variation. These variations were found in habitus, pseudobulb, leaves, and flowers (Dressler,  
 107 1993; Kartikaningrum et al., 2004; Hartati and Darsana, 2015). In this research ~~the~~  
 108 characterisation of the flower ~~wais~~ not ~~done-performed~~ because limited ~~organ~~-specimens  
 109 obtained ~~on-in~~ the field ~~and had not flowered yet~~.

110 Variation in habitus is seen in plant height, ~~which ranges from 50–125 cm. Plant height can~~  
 111 ~~be categorized into 2, namely  $\leq 100$  cm (short) and  $> 100$  cm (height)~~ (Figure 1).

112

**Comment [F2]:** No..habitus of orchids is not related to plant height. Please refer Dressler (1993) and Kartikaningrum et al (2204) for the definition of orchid habitus and the two types of orchid habits (monopodial and sympodial).

Furthermore, this manuscript only focussed on the leaf morphological characters. Better not to use plant height character as it is not related to leaf morphology. Moreover, plant height is commonly related to the plant age.

**Comment [F3]:** Better in Figure 1 focus on the leaf arrangement (phyllotaxis)



113  
 114 **Figure 14.** Habitus accession of *Dendrobium* samples in the Liwa Botanical Garden: A. CAT  
 115 274, B. CAT 144, C. CAT 140, D. IR 015, E. CAT 271.

**Comment [F4]:** Better in Figure 1 focus on the leaf arrangement (phyllotaxis). Suggestion for Pictures in Figure 1, Better to blur the path and focus on the picture of leaf arrangement

**Formatted:** Font: Italic

116  
 117 Based on observations, *Dendrobium* leaves are known as the most varied organs  
 118 (Table 2). Variations in leaf characters included leaf shape, length (P), width (L), tip shape,  
 119 cross section, arrangement, edge shape, surface texture, and symmetry.






**Comment [F5]:** Please check for the consistency abbreviation for leaf length and width

120  
 121 Overall, the accession of *Dendrobium* samples at the Liwa Botanical Garden showed  
 122 different morphological characters of the leaves, namely the cross-section and leaf  
 123 sitting arrangement. The leaf cross section of samples with accession number CAT 274, CAT

124 | 140, and IR 015 are semi terete, whereas that of sample with accession number CAT 144 is  
 125 | terate and CAT 271 is flat. In addition, leaf arrangement was found in all samples are  
 126 | alternate.

**Comment [F6]:** Please re-check and re-write..Leaf arrangement in all samples is alternate (the same)..it is contradicted with the first sentence in this paragraph leaf arrangement is different between samples

**Table 2.** Leaf Type of Accession of Dendrobium Samples in the Liwa Botanical Garden.  
 Bar = 1 cm.

No. Acc.	Leaf Shape
CAT140	
CAT144	
CAT271	
CAT274	
IR015	

127 |  
 128 | The different of ratio between leaf length and width between the five accession show  
 129 | that the shape of the leaves of the five accessions are different. The length and width of the

130 leaves differed from one sample to another. In CAT 274 samples (P: 4.5 cm and L: 1 cm),  
 131 CAT 144 samples (P: ± 1.7 cm and L: 0.5 cm), CAT 140 samples (P: 9.5 cm and L : 1.5 cm),  
 132 IR 015 samples (P: 8 cm and L: 2 cm), and CAT 271 samples (P: 8.5 cm and L: 1.5 cm).  
 133 In samples that have a longer leaf length morphological character CAT 140 (P: 9.5 cm  
 134 and L: 1.5 cm), IR015 (P: 8 cm and L: 2 cm) and CAT 271 (P: 8.5 cm and L: 1.5 cm) will  
 135 have a higher plant height habitus compared to samples that have shorter leaf morphological  
 136 characters in CAT 274 samples (P: 4.5 cm and L: 1 cm) and CAT 144 (P : ± 1.7 cm and L:  
 137 0.5 cm). Furthermore, there is also a striking difference in the morphological character of the  
 138 lowest plant leaves, namely in CAT 144 (P: ± 1.7 cm and L: 0.5 cm). Other character  
 139 differences also have the lowest plant height habitus and have a thicker leaf thickness than  
 140 the others. The complete identification of the morphology of the leaves of the *Dendrobium*  
 141 accession sample at the Liwa Botanical Garden is presented in Table 3.

**Table 3.** Variation of leaf character ~~results of morphological identification~~ of accession of *Dendrobium* samples in the Liwa Botanical Garden

Morphology Character	CAT 274	CAT 144	CAT 140	IR 015	CAT 271
Leaf Shape	Ovate	Triangular	Oblong	Lanceolate	Linear
Length (L) and width (W) of leaf	L: 4,5 cm W: 1 cm	L: ±1,7 cm W: 0,5 cm	L: 9,5 cm W: 1,5 cm	L: 8 cm W: 2 cm	L: 8,5 cm W: 1,5 cm
Leaf Tip	Obtuse	Acuminate	Obtuse	Acute	Acuminate
Leaf Cross Section	Semi terete	Terete	Semi terete	Semi terete	Flat
Arrangement of Leaves	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf Edge	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)
Leaf Surface Texture	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)
Leaf Symmetry	Symmetry	Symmetry	Symmetry	Symmetry	Symmetry

**Comment [F7]:** No need to discuss relationship between leaf size and plant height.

**Comment [F8]:** This is based on 8 morphological characters..in other parts it was mentioned using morphological characters. Please re-check

**Formatted:** Font: Italic

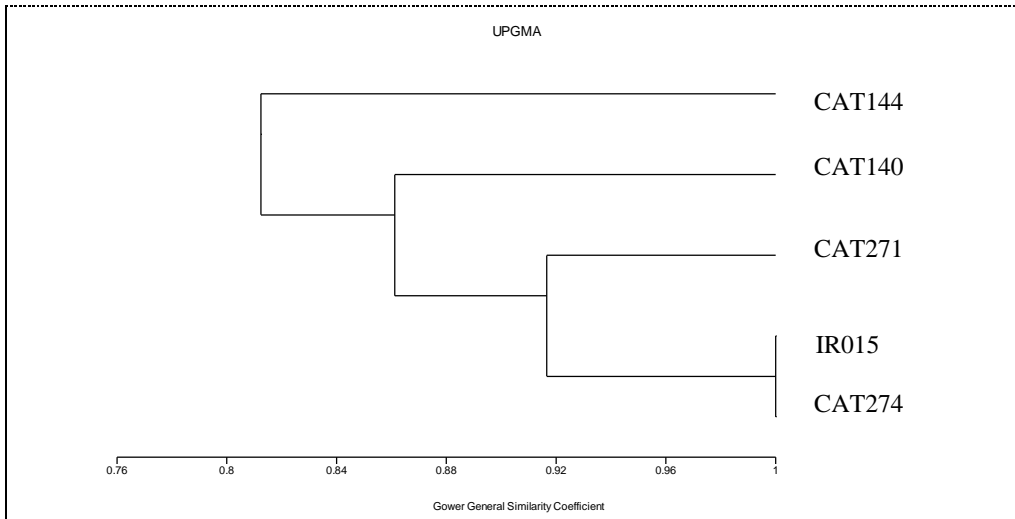
143 Based on Table 3, it is known that most of the accessions of *Dendrobium* samples in  
144 the Liwa Botanical Garden showed different morphological variation in the leaves. ~~In other~~  
145 ~~characters, namely the form of pseudobulb and the place of growth, it is known that the entire~~  
146 ~~accession of *Dendrobium* samples did not form pseudobulb and epiphytic types. Character~~  
147 ~~types of habitats in general all *Dendrobium* orchids have the same type, epiphytes, according~~  
148 ~~to natural conditions where the sample collection of the Liwa Botanical Garden is a natural~~  
149 ~~orchid taken from its natural habitat, such as the Bukit Barisan Selatan National Park and~~  
150 ~~Seminung Forest which has low humidity (dry) at an altitude of 800–900 m above sea level~~  
151 ~~(Solihah, 2015; Adi et al., 2019).~~

Comment [F9]:

### 153 3.3. Phenetic Analysis

154 Phenetic analysis on *Dendrobium* is performed through 2 methods, namely cluster  
155 analysis and PCA. Cluster analysis begins with the morphological character scoring, then the  
156 Gower (Gower's General Similarity) similarity value is calculated which results in a matrix  
157 of similarities between accessions. Then the similarity matrix data is done by agglomerative  
158 hierarchial clustering using the UPGMA method. The results of cluster analysis of 5  
159 *Dendrobium* accessions based on the characters produced by dendrogram are presented in  
160 Figure 2.





161 **Figure 2.** Dendrogram of 5 accessions of Dendrobium samples from the Liwa Botanical  
 162 Garden using UPGMA.

163

164 Grouping the sample based on the level of similarity between accessions calculated  
 165 using the gower coefficient formula and UPGMA was chosen for the clustering technique to  
 166 produce a dendrogram showing 2 main groups formed with a similarity index value of 0.813  
 167 marked as group A and group B. Group A consists of CAT 144 which has a distinguishing  
 168 character that distinguishes from group B, namely the cross section of the double leaf  
 169 character (Figure CAT 144). Group B consists of CAT 140, CAT 271, IR 015, and CAT 274  
 170 which have symmetrical cross-section characters (Figure CAT 140, CAT 271, IR 015, and  
 171 CAT 274). Group B is divided into 2 sub-groups with a similarity index value of 0.861  
 172 marked with B1 and B2 on the dendrogram. Characters that show the difference between the  
 173 two, namely the ratio of the length and width of the leaf and leaf arrangement. Subgroup B1  
 174 consists of CAT 140, while subgroup B2 consists of CAT 271, IR 015, and CAT 274. B2  
 175 subgroups are divided into 2 namely B2a and B2b based on differences in leaf length and  
 176 width ratios. The grouping of IR 015 and CAT 274 in one B2b group with a similarity level  
 177 of 100% indicates that they are the same type. Based on the Principle Component Analysis

**Comment [F10]:** No..The leaf arrangement w  
 previously mentioned as the same in all samples  
 (alternate). Please re-check

178 (PCA) values, it can be seen that the characters that have a large influence on grouping are

Comment [F11]: Where is the figure of PCA?

179 the ratio of leaf length and width (PLD), leaf cross section (PMD), and leaf ~~sitting~~  
180 ~~arrangement~~ (DKD). ~~Variability of orchid leaf characters can be possible due to the~~  
181 ~~hybridization and outcrossing processes.~~

182

#### 183 4. Conclusions

184 Five accessions ~~of Dendrobium~~ from Liwa Botanical Garden were identified to the  
185 level genus Dendrobium based on leaf morphological characters and phenetic relationships.

186 The observation of 11 morphological characters showed that leaf organs had high variations.

Comment [F12]: 11 or 8?

187 The phenetic relationship based on the Gower similarity value and the UPGMA method  
188 shows that the Dendrobium genus in the Liwa Botanical Garden can be classified into 2 main  
189 groups formed with a similarity index value of 0.813. Based on Principle Component analysis  
190 values, it is known that the characters that have a large influence on grouping are the ratio of  
191 leaf length and width, leaf cross section, and leaf arrangement. The resulting phenetic  
192 dendrogram topology is supported by the morphological character classification.

193

#### 194 Acknowledgements

195 This research was funded by Lembaga Penelitian dan Pengabdian Masyarakat  
196 (LPPM), Universitas Lampung through the DIPA BLU 2020 Grant with contract number  
197 1492 / UN26.21 / PN / 2020. Thank you to the Liwa Botanical Garden who facilitated the  
198 research. This activity is a continuation of the collaboration program with Department of  
199 Biology, Faculty of Mathematics and Natural Science, Universitas Lampung.

200

#### 201 References

Comment [F13]: Please check all through References and add more references

- 202 Adi, MC., Yulika, R., Nugraha, I. & Virditha, UA., 2019, *Buku Saku Kebun Raya Liwa*.  
203 *Badan Penelitian dan Pengembangan Kabupaten Lampung Barat*, UPTD Pengelola  
204 Kebun Raya Liwa, pp. 1-41.
- 205 Dressler, RL., 1993, *Phylogeny and Clasification of The Orchid Family*, Dioscorides Press,  
206 Porland, Oregon. pp. 1-314.
- 207 Hartati, S. & Darsana, L., 2015. Karakterisasi Anggrek Alam secara Morfologi dalam Rangka  
208 Pelestarian Plasma Nutfah. *J. Agron.* I43(2), 133-139.
- 209 Kartikaningrum, S., Widiastoety. D. & Effendie, K., 2004, *Panduan Karakterisasi Tanaman*  
210 *Hias: Anggrek dan Anthurium*, Badan Penelitian Dan Pengembangan Pertanian  
211 Komisi Nasional Plasma Nutfah, Jakarta, pp. 1-35.
- 212 Kumalawati, AD., Abdullah, S., Daryono, BS. & Mahfut, 2011, *Study on genetic diversity*  
213 *and conservation of orchids in Wonosadi forest, Gunung Kidul based on molecular*  
214 *analysis*, International Conference on Biological Science, Yogyakarta, Indonesia, pp.  
215 54.
- 216 Mahfut, Wahyuningsih, S. & Handayani, T.T., 2019, *Konservasi Anggrek Alam di Kebun*  
217 *Raya Liwa*. Laporan Hasil Penelitian. Universitas Lampung, pp. 1-15.
- 218 Solihah, SM., 2015, Koleksi, Status, dan Potensi Anggrek di Kebun Raya Liwa, *Warta*  
219 *Kebun Raya*, 13(1), 14-23.

220

221

222

223

# 1 Identification of *Dendrobium* in Liwa Botanical Garden Based on Leaf Morphological 2 Characters

## 3 4 Abstract

5 Orchid is one of the most popular ornamental plants in the world. One of the orchid genera  
6 that is collected in a large number and known to have high morphological variations in the  
7 Liwa Botanical Garden is *Dendrobium*. However, to date many *Dendrobium* collections have  
8 not been identified. Given the urgency of identification and the limitations of specimens in  
9 the field, especially flower organs, this study is important. This study aims to determine  
10 variations in morphological characters, phenetic relationships and to identify *Dendrobium*  
11 collections based on leaf morphological characters in the Liwa Botanical Garden. Five  
12 accessions of *Dendrobium* were collected, namely CAT140, CAT 144, CAT 271, CAT 274,  
13 and IR015. Observation of 11 morphological characters leaves showed that leaf had high  
14 variations. The phenetic relationship based on the Gower similarity value and the UPGMA  
15 method shows that the *Dendrobium* in the Liwa Botanical Garden can be classified into 2  
16 main groups formed with a similarity index value of 0.813. Based on Principle Component  
17 analysis values, it is known that the characters that have a large influence on grouping are the  
18 ratio of leaf length and width, leaf cross section, and leaf sitting. The resulting phenetic  
19 dendrogram topology is supported by the morphological character classification. The results  
20 of this study are expected to be basic information in the identification of natural orchids and  
21 conservation efforts in the Liwa Botanical Garden.

22  
23 Keywords: orchid, morphological leaf, identification, *Dendrobium*, UPGMA, Liwa Botanical  
24 Garden

25

26

27

28

29

30

31

32

33

## 34 1. Introduction

35 Orchidaceae (orchids) is one of the biggest plant families that consist of  
36 approximately 25,000 species belong to over 900 genera across the world. Orchids have high  
37 variations in the morphology of the flowers, leaves and stems (pseudobulbs). Dendrobium is  
38 one of orchid genera containing a large number of species (approximately 1500 species)  
39 widely spread across the world, from Japan, China, India, the Malacca Peninsula, Indonesia,  
40 the island of Papua, to Australia. This orchid has a charming flower (Dressler, 1993;  
41 Kartikaningrum et al., 2004; Kumalawati et al., 2011; Hartati and Darsana, 2015).

42

43 Dendrobium comes from the words "dendro" (tree) and "bios" (life). Dendrobium  
44 means orchids that grow on a living tree. Dendrobium has various shapes, sizes and colors of  
45 flowers. Flowers that have bloomed can last in one day to more than 30 days and each stem  
46 can have one to more than 20 flowers. Many Dendrobium grow at locations with an altitude  
47 less than 400 meters above sea level-(Solihah, 2015; Mahfut et al., 2019).

48

49 The Liwa Botanical Garden located in West Lampung Regency (Lampung, Sumatra island)  
50 is an institution that perform ex situ conservation of plants including orchids. Orchids have

51 been given high priority in the conservation because many orchids are threatened in the wild  
52 because of exploitation and overcollection for economic reasons that lead to the population  
53 decline and disappearance of many orchid species. Another threatening factor is deforestation  
54 causing the loss and damage of orchids' natural habitat that will have consequences of  
55 orchids are becoming extinct. Liwa Botanical Garden have an important role for preservation  
56 and conservation of plants including orchids. Many orchid species have been collected from  
57 the natural habitats for conservation purposes in the Liwa Botanical Gardens. However,  
58 many orchid species have not yet been identified in this gardens (Solihah, 2015; Adi et al.,  
59 2019; Mahfut et al., 2019).

61 Identification of orchid species is important in the orchid conservation. The present  
62 study focussed on the identification of some specimens of *Dendrobium* (one of the largest  
63 orchid genera) that will be based on the morphological characters as one of important tools in  
64 the plant's taxonomic and systemic basis. The morphological characters that will be used in  
65 the present study are leaf morphology. Given the urgency of identification and the limitations  
66 of specimens in the field, especially flower organs, this study is important. This study aims to  
67 determine variations in morphological characters and phenetic relationships for identification  
68 of *Dendrobium* in the Liwa Botanical Garden. The results of this study are expected to serve  
69 as basic information in the identification of natural orchids to support conservation in the  
70 Liwa Botanical Garden.

## 72 **2. Materials and methods**

### 73 2.1. *Sample collection*

74 Leaves of *Dendrobium* accessions in the Liwa Botanical Garden that are native to  
75 Lampung were collected as samples. The sample collection was conducted in December 2019

76 - February 2020 at the orchid green house in the Liwa Botanical Garden. *Dendrobium*

77 samples were chosen based on orchid data that had not yet been identified. All samples were  
78 tabulated and documented with photos.

79

80

## 81 2.2. The morphological identification

82 The morphological identification was performed by direct observation to the leaf  
83 morphology characters including leaf shape, length (P) and width (L)-tip shape, cross section,  
84 arrangement, edge shape, surface texture, symmetry, and arrangement (Dressler, 1993;  
85 Kartikaningrum et al., 2004; Hartati and Darsana, 2015).

86

## 87 2.3. Phenetic analysis

88 Phenetic analysis is done through cluster analysis methods and Principal Component  
89 Analysis (PCA). Cluster analysis begins with the morphological character scoring, then the  
90 Gower (Gower's General Similarity) similarity value is calculated which results in a matrix  
91 of similarity between accessions. Data matrix similarity is done by agglomerative hierarchical  
92 clustering using the UPGMA method and displayed in the form of dendrogram.

93

## 94 3. Results and Discussion

### 95 3.1. Sample collection

96 Collection results obtained 5 accessions of *Dendrobium* samples with sample codes  
97 CAT140, CAT 144, CAT 271, CAT 274, and IR015 (Table 1). Overall, the sample  
98 accessions are native orchids to Lampung.

99

100 **Table 1**. List of accessions of *Dendrobium* samples in the Liwa Botanical Garden

No. Acc.	Species	Origin Location
CAT140	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT144	<i>Dendrobium</i> sp.	Seminung Forest
CAT271	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT274	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
IR015	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park

101

### 102 3.2. The morphological identification

103 Based on observations of morphological characters, orchid plants have a high  
 104 variation. These variations were found in habitus, pseudobulb, leaves, and flowers (Dressler,  
 105 1993; Kartikaningrum et al., 2004; Hartati and Darsana, 2015). In this research the character  
 106 of the flower is not done because of limited organ specimens obtained on the field.

107 Variation in habitus is seen in plant height, which ranges from 50 - 125 cm. Plant height can  
 108 be categorized into 2, namely  $\leq 100$  cm (short) and  $> 100$  cm (height) (Figure 1).

109





110  
 111 **Figure 14.** Habitus accession of *Dendrobium* samples in the Liwa Botanical Garden: A. CAT  
 112 274, B. CAT 144, C. CAT 140, D. IR 015, E. CAT 271.

**Comment [A1]:** Please add scale bars to indicate the size of the plants

113  
 114 Based on observations, *Dendrobium* leaves are known as the most varied organs  
 115 (Table 2). Variations in leaf characters included leaf shape (S), length (P), width (L), tip  
 116 shape, cross section, arrangement, edge shape, surface texture, and symmetry.






117  
 118 Overall, the accession of *Dendrobium* samples at the Liwa Botanical Garden showed  
 119 different morphological characters of the leaves, namely the cross-section and leaf sitting.

120 The leaf cross section of samples with accession number CAT 274, CAT 140, and IR 015 are

121 | semi terete, whereas that of sample with accession number CAT 144 is terate and CAT 271 is  
122 | flat. In addition, leaf arrangement was found in all samples are alternate.

**Table 2.** Leaf Type of Accession of Dendrobium Samples in the Liwa Botanical Garden.  
Bar = 1 cm.

**Comment [A2]:** italic

No. Acc.	Leaf Shape
CAT140	
CAT144	
CAT271	
CAT274	
IR015	

123 |  
124 | The different of ratio between leaf length and width between the five accession show  
125 | that the shape of ~~the~~ leaves of the five accessions are different. The length and width of the  
126 | leaves differed from one sample to another. In CAT 274 samples (P: 4.5 cm and L: 1 cm),

127 CAT 144 samples (P:  $\pm$  1.7 cm and L: 0.5 cm), CAT 140 samples (P: 9.5 cm and L : 1.5 cm),  
 128 IR 015 samples (P: 8 cm and L: 2 cm), and CAT 271 samples (P: 8.5 cm and L: 1.5 cm).  
 129 In samples that have a longer leaf length morphological character CAT 140 (P: 9.5 cm  
 130 and L: 1.5 cm), IR015 (P: 8 cm and L: 2 cm) and CAT 271 (P: 8.5 cm and L: 1.5 cm) will  
 131 have a higher plant height habitus compared to samples that have shorter leaf morphological  
 132 characters in CAT 274 samples (P: 4.5 cm and L: 1 cm) and CAT 144 (P :  $\pm$  1.7 cm and L:  
 133 0.5 cm). Furthermore, there is also a striking difference in the morphological character of the  
 134 lowest plant leaves, namely in CAT 144 (P:  $\pm$  1.7 cm and L: 0.5 cm). Other character  
 135 differences also have the lowest plant height habitus and have a thicker leaf thickness than  
 136 the others. The complete identification of the morphology of the leaves of the *Dendrobium*  
 137 accession sample at the Liwa Botanical Garden is presented in Table 3.

**Table 3.** Variation of morphological leaf characters of leaves results of morphological identification of accession of *Dendrobium* samples accession in the Liwa Botanical Garden

Morphology Character	CAT 274	CAT 144	CAT 140	IR 015	CAT 271
Leaf Shape	Ovate	Triangular	Oblong	Lanceolate	Linear
Length (L) and width (W) of leaf	L: 4,5 cm W: 1 cm	L: $\pm$ 1,7 cm W: 0,5 cm	L: 9,5 cm W: 1,5 cm	L: 8 cm W: 2 cm	L: 8,5 cm W: 1,5 cm
Leaf Tip	Obtuse	Acuminate	Obtuse	Acute	Acuminate
Leaf Cross Section	Semi terete	Terete	Semi terete	Semi terete	Flat
Arrangement of Leaves	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf Edge	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)
Leaf Surface Texture	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)
Leaf Symmetry	Symmetry	Symmetry	Symmetry	Symmetry	Symmetry

Comment [A3]: italic

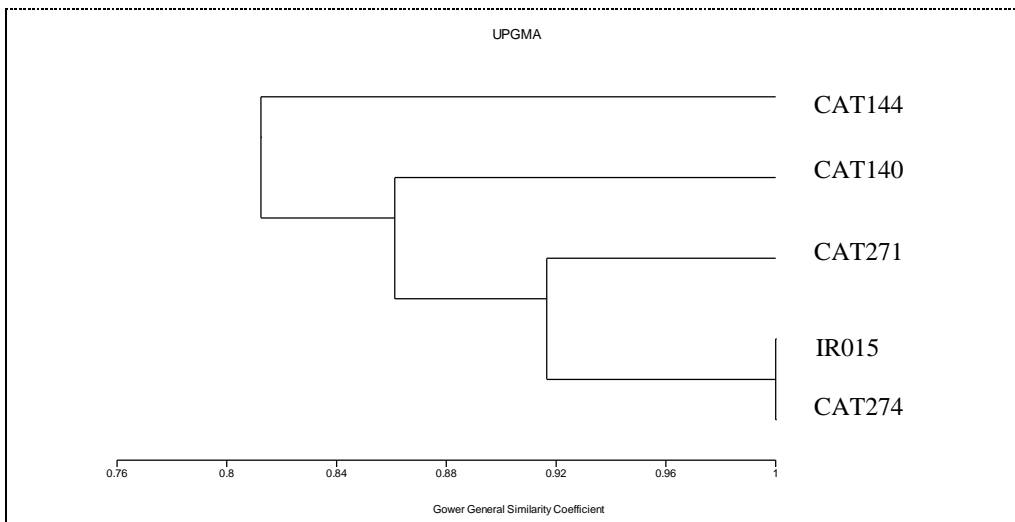
Comment [A4]: Table title needs to be revised

139           Based on Table 3, it is known that most of the accessions of *Dendrobium* samples in  
140 | the Liwa Botanical Garden showed different morphological ~~variation characters~~ in the leaves.  
141 | In other characters, namely the form of pseudobulb and the place of growth, it is known that  
142 | the entire accession of *Dendrobium* samples did not form pseudobulb and epiphytic types.  
143 | Character types of habitats in general all *Dendrobium* orchids have the same type, epiphytes,  
144 | according to natural conditions where the sample collection of the Liwa Botanical Garden is a  
145 | natural orchid taken from its natural habitat, such as the Bukit Barisan Selatan National Park  
146 | and Seminung Forest which has low humidity (dry) at an altitude of 800-900 m above sea  
147 | level (Solihah, 2015; Adi et al., 2019).

148

### 149 3.3. Phenetic Analysis

150 |           Phenetic analysis on *Dendrobium* is performed through 2 methods, namely cluster  
151 | analysis and PCA. Cluster analysis begins with the morphological character scoring, then the  
152 | Gower (Gower's General Similarity) similarity value is calculated which results in a matrix  
153 | of similarities between accessions. Then the similarity matrix data is done by agglomerative  
154 | hierarchial clustering using the UPGMA method. The results of cluster analysis of 5  
155 | *Dendrobium* accessions based on the characters produced by dendrogram are presented in  
156 | Figure 2.



157 **Figure 2.** Dendrogram of 5 accession of Dendrobium samples from the Liwa Botanical  
 158 Garden using UPGMA.

159

160 Grouping the sample based on the level of similarity between accessions calculated  
 161 using the gower coefficient formula and UPGMA was chosen for the clustering technique to  
 162 produce a dendrogram showing 2 main groups formed with a similarity index value of 0.813  
 163 marked as group A and group B. Group A consists of CAT 144 which has a distinguishing  
 164 character that distinguishes from group B, namely the cross section of the double leaf  
 165 character (Figure CAT 144). Group B consists of CAT 140, CAT 271, IR 015, and CAT 274  
 166 which have symmetrical cross-section characters (Figure CAT 140, CAT 271, IR 015, and  
 167 CAT 274). Group B is divided into 2 sub-groups with a similarity index value of 0.861  
 168 marked with B1 and B2 on the dendrogram. Characters that show the difference between the  
 169 two, namely the ratio of the length and width of the leaf and leaf arrangement. Subgroup B1  
 170 consists of CAT 140, while subgroup B2 consists of CAT 271, IR 015, and CAT 274. B2  
 171 subgroups are divided into 2 namely B2a and B2b based on differences in leaf length and  
 172 width ratios. The grouping of IR 015 and CAT 274 in one B2b group with a similarity level  
 173 of 100% indicates that they are the same type. Based on the Principle Component Analysis

174 (PCA) values, it can be seen that the characters that have a large influence on grouping are  
175 the ratio of leaf length and width (PLD), leaf cross section (PMD), and leaf sitting (DKD).  
176 Variability of orchid leaf characters can be possible due to the hybridization and natural  
177 outcrossing processes.

178

#### 179 4. Conclusions

180 Five accessions of Dendrobium from Liwa Botanical Garden were identified based on  
181 morphological characters and phenetic relationships. The observation of 11 morphological  
182 characters showed that leaf organs had high variations. The phenetic relationship based on the  
183 Gower similarity value and the UPGMA method shows that the Dendrobium genus in the  
184 Liwa Botanical Garden can be classified into 2 main groups formed with a similarity index  
185 value of 0.813. Based on Principle Component analysis values, it is known that the characters  
186 that have a large influence on grouping are the ratio of leaf length and width, leaf cross  
187 section, and leaf arrangement. The resulting phenetic dendrogram topology is supported by  
188 the classification of morphological characters ~~s-classification~~.

189

#### 190 Acknowledgements

191 This research was funded by Lembaga Penelitian dan Pengabdian Masyarakat  
192 (LPPM), Universitas Lampung through the DIPA BLU 2020 Grant with contract number  
193 1492 / UN26.21 / PN / 2020. Thank you to the Liwa Botanical Garden who facilitated the  
194 research. This activity is a continuation of the collaboration program with Department of  
195 Biology, Faculty of Mathematics and Natural Science, Universitas Lampung.

196

#### 197 References

**Comment [A5]:** the number of references is too small amount, it should be added with some new references related to the morphology of orchid leaves that published in the last 10 years

198 Adi, MC., Yulika, R., Nugraha, I. & Virditha, UA., 2019, *Buku Saku Kebun Raya Liwa*.  
199 *Badan Penelitian dan Pengembangan Kabupaten Lampung Barat*, UPTD Pengelola  
200 Kebun Raya Liwa, pp. 1-41.

201 Dressler, RL., 1993, *Phylogeny and Clasification of The Orchid Family*, Dioscorides Press,  
202 Porland, Oregon. pp. 1-314.

203 Hartati, S. & Darsana, L., 2015. Karakterisasi Anggrek Alam secara Morfologi dalam Rangka  
204 Pelestarian Plasma Nutfah. *J. Agron.* I43(2), 133-139.

205 Kartikaningrum, S., Widiastoety. D. & Effendie, K., 2004, *Panduan Karakterisasi Tanaman*  
206 *Hias: Anggrek dan Anthurium*, Badan Penelitian Dan Pengembangan Pertanian  
207 Komisi Nasional Plasma Nutfah, Jakarta, pp. 1-35.

208 Kumalawati, AD., Abdullah, S., Daryono, BS. & Mahfut, 2011, *Study on genetic diversity*  
209 *and conservation of orchids in Wonosadi forest, Gunung Kidul based on molecular*  
210 *analysis*, International Conference on Biological Science, Yogyakarta, Indonesia, pp.  
211 54.

212 Mahfut, Wahyuningsih, S. & Handayani, T.T., 2019, *Konservasi Anggrek Alam di Kebun*  
213 *Raya Liwa*. Laporan Hasil Penelitian. Universitas Lampung, pp. 1-15.

214 Solihah, SM., 2015, Koleksi, Status, dan Potensi Anggrek di Kebun Raya Liwa, *Warta*  
215 *Kebun Raya*, 13(1), 14-23.

216  
217  
218  
219

**7.**

**Editor Decision -  
Short Communication**



Compose

Back

Archive

Move

Delete

Spam

Settings

[JTBB] Editor Decision

Yahoo/Inbox

Sri Nopitasari ...Biotechnology http://jtbb.or.id ISSN 2540-9573 (print)...

Sun, Dec 20, 2020 at 9:40 AM

Sri Nopitasari ...Biotechnology http://jtbb.or.id ISSN 2540-9573 (print)...

Sun, Dec 27, 2020 at 10:18 PM

Sri Nopitasari <sri.nopitasari2809@gmail.com>
To: Mahfut Mahfut Mahfut
Cc: Mahfut Mahfut, Tundjung Tripeni Handayani, Sri Wahyuningsih, Sukimin Sukimin

Mon, Jan 25, 2021 at 10:02 AM

Dear Dr. Mahfut,

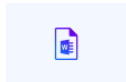
Based on the review comments, it states that the data is lacking for the identification method and requires other supporting data such as anatomical and molecular characters. So, the editor decided if this manuscript was converted into short communication. Please change the manuscript and confirm the author's willingness to change it.

We expect to receive your revision within one week. If you fail to turn your revision in within the designated time, we may have to decline your manuscript without notification.

If you have any questions, please feel free to contact us.

Sincerely yours,
Sri Nopitasari
Journal of Tropical Biodiversity and Biotechnology
sri.nopitasari2809@gmail.com

Journal of Tropical Biodiversity and Biotechnology
http://jtbb.or.id
ISSN 2540-9573 (print)
ISSN 2540-9581 (online)



shortcomm\_....doc
111.5kB

Navigation arrows

Dr. Miftahul Ilmi ...Biotechnology http://jtbb.or.id ISSN 2540-9573 (print)...

Tue, Feb 9, 2021 at 5:25 PM

Reply, Reply All or Forward

Send

Rich text editor icons

User profile for Sri Nopitasari with contact info and add to contacts button

Advertisement for yahoo!mail TERATUR SPESIAL KEREN with a woman holding a phone

Advertisement for yahoo!mail with a woman holding a phone

**8.**

**Acceptance Letter**  
**Artikel**

Compose

Back

Archive Move Delete Spam

Yahoo/Inbox

Settings

[JTBB] Editor Decision

Sri Nopitasari ...Biotechnology http://jtbb.or.id ISSN 2540-9573 (print)...

Sun, Dec 20, 2020 at 9:40 AM

Sri Nopitasari ...Biotechnology http://jtbb.or.id ISSN 2540-9573 (print)...

Sun, Dec 27, 2020 at 10:18 PM

Sri Nopitasari ...Biotechnology http://jtbb.or.id ISSN 2540-9573 (print)...

Mon, Jan 25, 2021 at 10:02 AM

Dr. Miftahul Ilmi <m.ilmi@ugm.ac.id>
To: Mahfut Mahfut Mahfut
Cc: Mahfut Mahfut, Tundjung Tripeni Handayani, Sri Wahyuningsih, Sukimin Sukimin

Tue, Feb 9, 2021 at 5:25 PM

Dear Mahfut Mahfut Mahfut:

Thank you for submitting your work, titled "Identification of Dendrobium in the Liwa Botanical Garden Based on Morphological Characters", to Journal of Tropical Biodiversity and Biotechnology. After reviewing your submission, we decided to accept your manuscript for publication.

Shortly after this, our copyeditor will contact you to review the final edited version of your manuscript. Please keep in mind that we will not publish the manuscript before you approve the final version.

If you have any questions, please feel free to contact us.

Sincerely yours,
Dr. Miftahul Ilmi
Faculty of Biology, Universitas Gadjah Mada
m.ilmi@ugm.ac.id

Journal of Tropical Biodiversity and Biotechnology
http://jtbb.or.id
ISSN 2540-9573 (print)
ISSN 2540-9581 (online)

Navigation icons

Reply, Reply All or Forward

Send

Rich text editor icons

Dr. Miftahul Ilmi profile card with contact info

Sniffer430 advertisement for underground leak detection

Underfloor leak detection advertisement

- Inbox 281
Unread
Starred
Drafts
Sent
Archive
Spam
Trash
Less
Views Hide
Photos
Documents
Subscriptions
Shopping
Receipts
Travel
Folders Hide
New Folder

**9.**

# **Proofread Layout**

Compose

- Inbox 281
- Unread
- Starred
- Drafts
- Sent
- Archive
- Spam
- Trash
- Less
- Views Hide
- Photos
- Documents
- Subscriptions
- Shopping
- Receipts
- Travel
- Folders Hide
- + New Folder

← Back

[JTBB] Proofread Layout Yahoo/Inbox

**Salwa Shabria Wafi** <wafisalwa@gmail.com>  
 To: Mahfut Mahfut, Tundjung Tripeni Handayani, Sri Wahyuningsih, Sukimin Sukimin

Dear Author(s),

We would like to inform you that we have finished the final draft layout of your article entitled "Identification of Dendrobium in the Liwa Botanical Garden Based on Morphological Characters". Please kindly check it on the attached file below and leave notes if there are any changes that should be made with it. We would also like to remind you to recheck the authors name and affiliation in the layout and metadata, since we will not accept revision once it is published later.

Thank you very much.

Best regards,

Salwa Shabria Wafi  
 Admin of JTBB.

Journal of Tropical Biodiversity and Biotechnology  
<http://jtbb.or.id>  
 ISSN 2540-9573 (print)  
 ISSN 2540-9581 (online)



Reply, Reply All or Forward

Received.    Received, thank you.    Thank you.

Send

Shortcom 4 JTBB-Mahfut-draft.pdf Page 1 of 6

Journal of Tropical Biodiversity and Biotechnology  
 Volume 06, Issue 01 (2021): jtb6.01.023  
 DOI: 10.22146/jtb6.01.023

Short Communication

### Identification of *Dendrobium* (Orchidaceae) in Liwa Botanical Garden Based on Leaf Morphological Characters

Mahfut<sup>1</sup>, Tundjung Tripeni Handayani<sup>1</sup>, Sri Wahyuningsih<sup>1</sup>, Sukimin<sup>2</sup>  
<sup>1</sup>Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung, Jl. Sumanti Bejenegara No 1, Bandar Lampung, Indonesia 35141.  
<sup>2</sup>Liwa Botanical Garden, Way Mangala, Bukit Bukit, Lampung Barat, Lampung, Indonesia 34214  
 \* Corresponding author, email: mahfutmpj@fmpj.unila.ac.id

Submitted: 05 September 2020; Accepted: 05 February 2021; Published online: xxxx

**ABSTRACT**

Orchid is one of the most popular ornamental plants in the world. One of the orchid genera that is collected in a large number and known to have high morphological variations in the Liwa Botanical Garden is *Dendrobium*. However, to date, many *Dendrobium* collections have not been identified. Given the urgency of identification and the limitations of specimens in the field, especially flower organs, this study is important. This study aims to determine variations in morphological characters, phenetic relationships, and to identify *Dendrobium* collections based on leaf morphological characters in the Liwa Botanical Garden. Five specimens of *Dendrobium* were collected, namely CAT140, CAT 144, CAT 271, CAT 274, and TR015. Observation of 11 morphological characters leaves showed that leaf had high variations. The phenetic relationship based on the Gower similarity value and the UPGMA method shows that the *Dendrobium* in the Liwa Botanical Garden can be classified into 2 main groups formed with a similarity index value of 0.813. Based on Principle Component analysis values, it is known that the characters that have a large influence on grouping are the ratio of leaf length and width, leaf cross section, and leaf arrangement. The phenetic dendrogram topology is supported by the morphological character classification. The results of this study are expected to be basic information in the identification of natural orchids and conservation efforts in the Liwa Botanical Garden.

**Keywords:** orchid, morphological leaf, identification, *Dendrobium*, UPGMA, Liwa Botanical Garden

## Short Communication

# Identification of *Dendrobium* (Orchidaceae) in Liwa Botanical Garden Based on Leaf Morphological Characters

Mahfut<sup>1\*</sup>, Tundjung Tripeni Handayani<sup>1</sup>, Sri Wahyuningsih<sup>1</sup>, Sukimin<sup>2</sup>

1) Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung, Jl. Sumantri Brojonegoro No 1, Bandar Lampung, Indonesia. 35141.

2) Liwa Botanical Garden. Way Mengaku, Balik Bukit, Lampung Barat, Lampung, Indonesia. 34814

\* Corresponding author, email: mahfut.mipa@fmipa.unila.ac.id

Submitted: 03 September 2020; Accepted: 09 February 2021; Published online: xxxx

### ABSTRACT

Orchid is one of the most popular ornamental plants in the world. One of the orchid genera that is collected in a large number and known to have high morphological variations in the Liwa Botanical Garden is *Dendrobium*. However, to date, many *Dendrobium* collections have not been identified. Given the urgency of identification and the limitations of specimens in the field, especially flower organs, this study is important. This study aims to determine variations in morphological characters, phenetic relationships, and to identify *Dendrobium* collections based on leaf morphological characters in the Liwa Botanical Garden. Five accessions of *Dendrobium* were collected, namely CAT140, CAT 144, CAT 271, CAT 274, and IR015. Observation of 11 morphological characters leaves showed that leaf had high variations. The phenetic relationship based on the Gower similarity value and the UPGMA method shows that the *Dendrobium* in the Liwa Botanical Garden can be classified into 2 main groups formed with a similarity index value of 0.813. Based on Principle Component analysis values, it is known that the characters that have a large influence on grouping are the ratio of leaf length and width, leaf cross section, and leaf arrangement. The phenetic dendrogram topology is supported by the morphological character classification. The results of this study are expected to be basic information in the identification of natural orchids and conservation efforts in the Liwa Botanical Garden.

**Keywords:** orchid, morphological leaf, identification, *Dendrobium*, UPGMA, Liwa Botanical Garden

Orchidaceae (orchids) is one of the biggest plant families that consist of approximately 25,000 species belongs to over 900 genera across the world. Orchids have high variations in the morphology of the flowers, leaves, and stems (pseudobulbs). *Dendrobium* is one of the orchid genera containing a large number of species (approximately 1500 species) widely spread across the world, from Japan, China, India, the Malacca Peninsula, Indonesia, the island of Papua, to Australia. This orchid has a charming flower ([Dressler 1993](#); [Kartikaningrum et al. 2004](#); [Kumalawati et al. 2011](#); [Hartati & Darsana 2015](#)).

*Dendrobium* comes from the words "dendro" (tree) and "bios" (life). *Dendrobium* means orchids that grow on a living tree. *Dendrobium* has various shapes, sizes, and colors of flowers. Flowers that have bloomed can last in

one day to more than 30 days and each stem can have one to more than 20 flowers. Many *Dendrobium* grows at locations with an altitude less than 400 meters above sea level ([Pang et al. 2012](#); [De et al. 2015](#); [Darmawati et al. 2018](#); [Indraloka et al. 2019](#); [Zahara & Win 2019](#); [Yuan et al. 2020](#)).

The Liwa Botanical Garden located in West Lampung Regency (Lampung, Sumatra island) is an institution that performs ex situ conservation of plants including orchids. Orchids have been given high priority in conservation because many orchids are threatened in the wild because of exploitation and overcollection for economic reasons that lead to the population decline and disappearance of many orchid species. Another threatening factor is deforestation causing the loss and damage of orchids, a natural habitat that will lead to the extinction of orchids. Liwa Botanical Garden has an important role in the preservation and conservation of plants including orchids. Many orchid species have been collected from the natural habitats for conservation purposes in the Liwa Botanical Gardens. However, many orchid species have not yet been identified in these gardens ([Solihah 2015](#); [Adi et al. 2019](#); [Mahfut et al. 2019](#)).

Identification of orchid species is important in orchid conservation. The present study focussed on the identification of some specimens of *Dendrobium* (one of the largest orchid genera) that will be based on the morphological characters as one of the important tools in the plant's taxonomic and systemic basis. The morphological characters that will be used in the present study are leaf morphology. Given the urgency of identification and the limitations of specimens in the field, especially flower organs, this study is important. This study aims to determine variations in morphological characters and phenetic relationships for the identification of *Dendrobium* in the Liwa Botanical Garden. The results of this study are expected to serve as basic information in the identification of natural orchids to support conservation in the Liwa Botanical Garden.

### Sample collection

Sample collections that were identified based on leaf morphological characters included 5 accessions with sample codes CAT140, CAT 144, CAT 271, CAT 274, and IR015 (Table 1). *Dendrobium* samples were chosen based on orchid data that had not yet been identified. Overall, the sample accessions are native orchids to Lampung.

**Table 1.** List of accessions of *Dendrobium* samples in the Liwa Botanical Garden.

No. Acc.	Species	Origin Location
CAT140	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT144	<i>Dendrobium</i> sp.	Seminung Forest
CAT271	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
CAT274	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park
IR015	<i>Dendrobium</i> sp.	Bukit Barisan Selatan National Park

### The morphological identification






The morphological identification was performed by direct observation to the leaf morphology characters including leaf shape, length (L) and width (W) tip shape, cross section, arrangement, edge shape, surface texture, symmetry, and arrangement ([Dressler 1993](#); [Kartikaningrum et al. 2004](#); [Hartati & Darsana 2015](#)).

Based on observations of morphological characters, orchid plants have a high variation. These variations were found in habitus, pseudobulb, leaves, and flowers ([Dressler 1993](#); [Kartikaningrum et al. 2004](#); [Hartati & Darsana](#)

2015). In this research characterization of the flower was not performed because limited specimens were obtained in the field and had not flowered yet.

Based on observations, *Dendrobium* leaves are known as the most varied organs (Table 2). Variations in leaf characters included leaf shape (S), length (L), width (W), tip shape, cross section, arrangement, edge shape, surface texture, and symmetry. Overall, the accession of *Dendrobium* samples at the Liwa Botanical Garden showed different morphological characters of the leaves, namely the cross-section. The leaf cross section of samples with accession numbers CAT 274, CAT 140, and IR 015 are semi terete, whereas that of a sample with accession number CAT 144 is terate and CAT 271 is flat. In addition, leaf arrangement was found in all samples are alternate.

**Table 2.** Leaf Type of Accession of *Dendrobium* samples in the Liwa Botanical Garden. Bar = 1 cm.

No. Acc	Leaf Shape
CAT140	
CAT144	
CAT271	
CAT274	
IR015	



The ratio difference between leaf length and width between the five accessions show that the shapes of the leaves of the five accessions are different. The complete identification of the morphology of the leaves of the *Dendrobium* accession sample at the Liwa Botanical Garden is presented in Table 3.

**Table 3.** Variation of morphological characters of the accession of *Dendrobium* samples in the Liwa Botanical Garden.

Morphology Character	CAT 274	CAT 144	CAT 140	IR 015	CAT 271
Leaf Shape (S)	Ovate	Triangular	Oblong	Lanceolate	Llinear
Length (L) and width (W) of leaf	L: 4,5 cm W: 1 cm	L: ±1,7 cm W: 0,5 cm	L: 9,5 cm W: 1,5 cm	L: 8 cm W: 2 cm	L: 8,5 cm W: 1,5 cm
Leaf Tip	Obtuse	Acuminate	Obtuse	Acute	Acuminate
Leaf Cross Section	Semi terete	Terete	Semi terete	Semi terete	Flat
Arrangement of Leaves	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf Edge	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)	Frayed (flat)
Leaf Surface Texture	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)	Hairless (smooth)
Leaf Symmetry	Symmetry	Symmetry	Symmetry	Symmetry	Symmetry

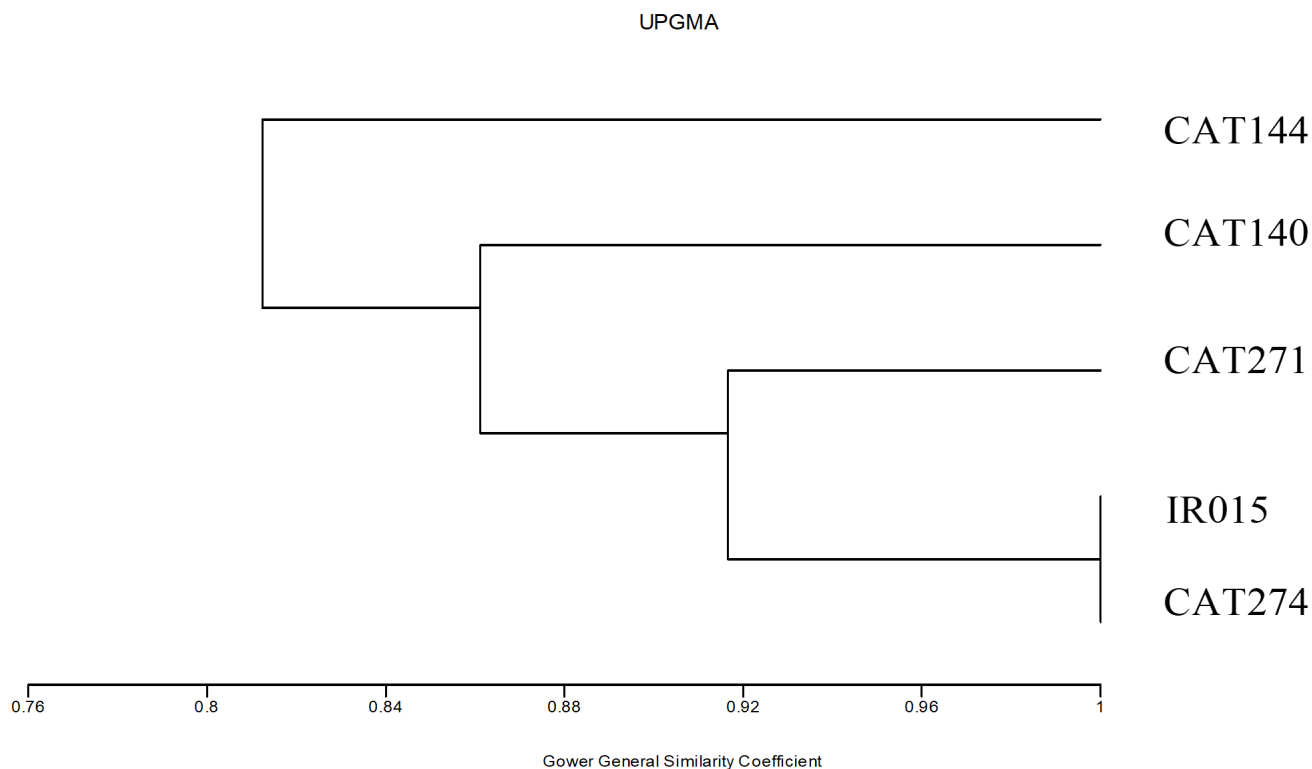
Based on Table 3, it is known that most of the accessions of *Dendrobium* samples in the Liwa Botanical Garden showed different morphological characters in the leaves.

### Phenetic Analysis

The Phenetic analysis is performed through cluster analysis methods and Principal Component Analysis (PCA). Cluster analysis begins with the morphological character scoring, then the Gower (Gower's General Similarity) similarity value is calculated which results in a matrix of similarity between accessions. Data matrix similarity is done by agglomerative hierarchical clustering using the UPGMA method and displayed in the form of a dendrogram.

Phenetic analysis on *Dendrobium* is performed through 2 methods, namely cluster analysis, and PCA. Cluster analysis begins with the morphological character scoring, then the Gower (Gower's General Similarity) similarity value is calculated which results in a matrix of similarities between accessions. Then the similarity matrix data is done by agglomerative hierarchical clustering using the UPGMA method. The results of cluster analysis of 5 *Dendrobium* accessions based on the characters produced by the dendrogram are presented in Figure 1.

Grouping the sample based on the level of similarity between accessions calculated using the gower coefficient formula and UPGMA was chosen for the clustering technique to produce a dendrogram showing 2 main groups formed with a similarity index value of 0.813 marked as group A and group B. Group A consists of CAT 144 which has a distinguishing character that distinguishes from group B, namely the cross section of the double leaf character (Figure CAT 144). Group B consists of CAT 140, CAT 271, IR 015, and CAT 274 which have symmetrical cross-section characters (Figure CAT 140, CAT 271, IR 015, and CAT 274). Group B is divided into 2 sub-groups with a similarity index value of 0.861 marked with B1 and B2



**Figure 1.** Dendrogram of 5 accessions *Dendrobium* samples from the Liwa Botanical Garden using UPGMA.

on the dendrogram. Characters that show the difference on ratio of the length and width of the leaf and leaf arrangement are same in all samples. Subgroup B1 consists of CAT 140, while subgroup B2 consists of CAT 271, IR 015, and CAT 274. B2 subgroups are divided into 2 namely B2a and B2b based on differences in leaf length and width ratios. The grouping of IR 015 and CAT 274 in one B2b group with a similarity level of 100% indicates that they are the same type. Based on the PCA values, it can be seen that the characters that have a large influence on grouping are the ratio of leaf length and width (PLD), leaf cross section (PMD), and leaf arrangement (DKD).

### AUTHOR CONTRIBUTION

M is the main researcher who conceptualized and collected data. He did data analysis and interpretation and drafted and finalized this manuscript. S is the supervisor at Liwa Botanical Garden, he is with TTH and SW are provided the guidance from conceptualization of the research objectives, methodology, data collection, analysis, and interpretation of the results. All were key in the development, drafting later on and finalizing of this manuscript.

### ACKNOWLEDGMENTS

This research was funded by Lembaga Penelitian dan Pengabdian Masyarakat (LPPM), Universitas Lampung through the DIPA BLU 2020 Grant with contract number 1492 / UN26.21 / PN / 2020. Thank you to Liwa Botanical Garden who facilitated the research. This activity is a continuation of the collaboration program with Department of Biology, Faculty of Mathematics and Natural Science, Universitas Lampung.

### CONFLICT OF INTEREST

The authors report no conflicts of interest regarding the research or the research funding.

## REFERENCES

- Adi, MC. et al., 2019. Buku Saku Kebun Raya Liwa. Badan Penelitian dan Pengembangan Kabupaten Lampung Barat. *UPTD Pengelola Kebun Raya Liwa*, 41.
- Darmawati, IAP. et al., 2018. The Diversity of Wild Dendrobium (Orchidaceae) in Central Bali, Indonesia. *Biodiversitas*, 19(3), pp.1110-1116.
- De, LC. et al., 2015. Morphological Characterization In Dendrobium Species. *Journal of Global Biosciences*, 4(1), pp.1198-1215.
- Dressler, RL., 1993. Phylogeny and Clasification of The Orchid Family. *Dioscorides Press, Porland, Oregon*, 314.
- Hartati, S. & Darsana, L., 2015. Karakterisasi Anggrek Alam secara Morfologi dalam Rangka Pelestarian Plasma Nutfah. *Jurnal Agronomi Indonesia*. 43(2), pp.133-139.
- Indraloka, AB. et al., 2019. Morphological Characteristics And Pollinia Observation of 10 Indonesia Native Dendrobium Orchids. *Biovalentia*, 5(2), pp.38-45.
- Kartikaningrum, S. et al., 2004. Panduan Karakterisasi Tanaman Hias: Anggrek dan Anthurium. *Badan Penelitian Dan Pengembangan Pertanian Komisi Nasional Plasma Nutfah*, 35.
- Kumalawati, AD. et al., 2011. Study on Genetic Diversity and Conservation of Orchids in Wonosadi Forest, Gunung Kidul Based on Molecular Analysis. *International Conference on Biological Science*, 54.
- Mahfut et al., 2019. Konservasi Anggrek Alam di Kebun Raya Liwa. *Laporan Hasil Penelitian Universitas Lampung*, 15.
- Pang, S. et al., 2012. Floral morphology and reproductive biology of Dendrobium jiajiangense (Orchidaceae) in Mt. Fotang, Southwestern China. *Flora-Morphology, Distribution, Functional Ecology of Plants*, 207(6), pp.469-474.
- Solihah, SM., 2015. Koleksi, Status, dan Potensi Anggrek di Kebun Raya Liwa. *Warta Kebun Raya*. 13(1), pp.14-23.
- Yuan, Y. et al., 2020. The major factors influencing distribution of three species of Dendrobium: Analysis of potential ecologically suitable distributions. *Journal of Applied Research on Medicinal and Aromatic Plants*. 19, pp.100275.
- Zahara, M. & Win, CC. 2019. Morphological and Stomatal Characteristics of Two Indonesian Local Orchids. *Journal of Tropical Horticulture*. 2(2), pp.65-69.