Morphology characteristics of orchids species in Bukit Barisan, Bengkulu province

Miswarti1*, I Calista1, W E Putra1, Y Oktavia1, S Yuliasari1, D Musaddad2 and Y Sastro1

1Assessment Institute for Agricultural Technology of Bengkulu, Jalan Irian Km 6.5 Bengkulu 38119, Indonesia
2Balitsa, Jl. Tangkuban Perahu 517, Lembang 40391, Indonesia

Corresponding author: misbachza@yahoo.co.id

Abstract. The species orchid is one of the rich local genetic resources of Bengkulu Province. Information on the diversity of orchid species in Bengkulu has not been widely disclosed, so characterization is needed. This study aims to identify and characterize orchid species based on morphological characters. The study was carried out in Bukit Barisan, Central Bengkulu, Kepahiang, Rejang Lebong and Lebong from April to December 2018. The orchid data collection was carried out by exploration methods and direct observation of orchid plants in situ and exitu. In-situ observations were made on all orchid species found in their habitat and were flowering or fruiting, while the external observations were made on orchids that were not flowering and bearing fruit in their habitat. The samples of these orchids are collected and maintained beforehand until they grow flowers and fruit. Observations were made on morphological characteristics, namely the growth pattern of stems, pseudobulbs, leaves, flowers and fruit. Determination of the types of orchids identified in accordance with orchid guidelines. There are 15 genera consisting of 34 types of orchids with various forms of stem growth, pseudobulbs, leaves and flower colors.

1. Introduction

Indonesia is one of the biodiversity countries which has the largest tropical rainforest in the world with a very high diversity of genetic resources including orchids. Orchids are among the fifth most abundant plants in the world and grow as epiphytes and terrestrial [1]. The number is estimated at more than 26,000 species and 5,000-6000 species are in Indonesia. Puspitaningtyas [2] mention 1,327 species grow on the island of Java and the rest grow on the islands of Sumatra, Kalimantan, Sulawesi, Irian Jaya, and other islands. Bengkulu Province is one in Sumatra which is famous for its Bukit Barisan with a diverse topography in which there is a lot of high biodiversity and one of them is natural orchids or forest orchids. Tropika et al [3] found 1118 species of orchids in the Sumatra region, 458 of which are endemic to Sumatra, especially in mountainous areas in the Bukit Barisan. These orchids are known as species orchids. Natural orchids or species orchids are orchids that have not undergone a cross that are still living naturally in their natural habitat. The wealth of natural orchids is widely distributed in forest areas, topography or other vegetation. In Bengkulu, the diversity of orchids is estimated to be reduced or threatened with extinction in line with forest destruction due to forest burning, land use change for road construction and settlement. On the other hand, orchid diversity is a very valuable asset and will not be valuable if not utilized. So far, the information on the diversity of orchids in Bengkulu has not been
disclosed, so it needs to be characterized. The purpose of this study was to determine the types of orchids and their morphological characteristics.

2. Methodology
Exploratory research was carried out in four districts, namely Bengkulu Tengah Regency, Kepahiang Regency, Rejang Lebong Regency and Lebong Regency at an altitude of 300-1000 m above sea level using the roaming and observation method, from March to December 2018. The materials and tools used are orchids, plastic bags, rulers, scissors, ropes, duct tape, stationery, Royal Horticulture society, cameras. The data collected consists of primary data and secondary data. Primary data for orchids were observed in situ and exitu orchid plants. In-situ observations were made on all orchid species found in their habitat and were flowering or fruiting, while the external observations were made on orchids that were not flowering and bearing fruit in their habitat. The samples of these orchids are collected and maintained first until they grow flowers and fruit. Meanwhile, the secondary data were obtained from BPS. Observations were made on morphological characteristics, namely the growth patterns of stems, pseudobulbs, leaves, flowers and fruit. Determination of the types of orchids identified according to orchid guidelines.

3. Results and discussion
3.1. General description of growing environment
Geographically, Bengkulu Tengah Regency, Kepahiang Regency, Rejang Lebong Regency and Lebong Regency are areas located in the mountains of the Bukit Barisan, most of which are located at an altitude of 400-1000 meters above sea level (asl). Soil relief is dominated by hilly areas with a wavy, sharp and steep slope. Alzate et al Stated [4], efifit orchids can grow in the lowlands to the highlands, but the plains at an altitude of 500 - 1500 m above sea level are suitable places for orchids because the diversity of orchid types is more than in the lowlands. Based on reports from BMKG Kab. Kepahiang (the closest station in the 4 districts), is presented in Figure 1.

![Climate Condition in Kepahiang Regency](image_url)

**Figure 1. Climate Condition**
Optimal orchid growth will have a positive impact on the flowering process. The distribution and preservation of orchid genetic resources in Bukit Barisan is influenced by climate [5]. The recorded temperatures ranged from 23.94 and 24.06 degrees Celsius. Orchids grow at an altitude of 0-2000 m above sea level, the temperature needed for orchid growth ranges from 21-35 °C [6]. Furthermore, there are two main factors that affect orchid growth, namely intrinsic factors and extrinsic factors [7]. Intrinsic factors that influence the flowering process include: genes, endogenous hormones, and plant age. Meanwhile, extrinsic factors that influence the flowering process include: light, temperature, humidity, nutrient availability, and external induction of phytohormones. All of these factors are interrelated to support optimal plant growth.

3.2. Identification and characterization of local orchids
Based on the identification results, it was found that the orchids found were very diverse, namely 34 species, most of which were 91.17% of the epiphytic orchids and 8.82% were ground orchids (Table 1). Sumatra is one of the regions rich in epiphytic orchids. Epiphytic orchids are orchids that are attached to trunks, branches or branches of living or dead trees as their living substrate.

| Genera    | No | Type                        | Growing Habitat       | Location     |
|-----------|----|-----------------------------|------------------------|--------------|
| Arundina  | 1  | Arundina Graminifolia       | Teresterial, litotif   | RL, LB       |
| Phaius    | 2  | Phaius tankervilleae        | Teresterial            | RL, LB       |
| Spathoglottis | 3   | Spathoglottis plicata     | Teresterial            | RL, KPH      |
| Grammathophyllum | 4    | Grammathophyllum speciosum | Effit                  | LB           |
|            | 5  | Grammathophyllum stapeliiflorum | Effit                  | RL           |
| Agrostophyllum | 6    | Agrostophyllum stipulatum | Effit                  | BT, RI       |
|            | 7  | Agrostophyllum majus        | Effit                  | RL           |
|            | 8  | Agrostophyllum acuminatum   | Effit                  | KPH          |
| Cymbidium | 9  | Cymbidium Finlaysonianum    | Effit                  | BT, RL       |
|           | 10 | Cymbidium aloifolium        | Effit                  | BT, KPH      |
| Cologyne  | 11 | Cologyne pandurate          | Effit                  | RL           |
|           | 12 | Cologyne pulverula          | Effit                  | RL           |
|           | 13 | CologynePrasina             | Effit                  | RL           |
|           | 14 | Cologyne speciosa           | Effit                  | BT, KPH      |
| Pholidota | 15 | Pholidota imbricate         | Effit                  | KPH, RL      |
| Apendicula | 16  | Apendicula                 | Effit                  | BT           |
| Aporum    | 17 | Aporum Indivisum Blume     | Effit                  | BT           |
|           | 18 | Aporum acinaciforme        | Effit                  | BT           |
| Dendrobium| 19 | Dendrobium uncatum          | Effit                  | BT/KPH       |
|           | 20 | Dendrobium linearfolium    | Effit                  | KPH, RL      |
|           | 21 | Oberonia anceps            | Effit                  | BT           |
|           | 22 | Dendrobium crumentum       | Effit                  | BT, KPH, RL, LB |
|           | 23 | Dendrobium annae           | Effit                  | RL           |
|           | 24 | Dendrobium linearfolium    | Effit                  | KPH, RL      |
| Acriopsis | 25 | Acriopsis liliifolia       | Effit                  | BT           |
|           | 26 | Acriopsis javanica Reinw   | Effit                  | BT           |
| Vanda     | 27 | Pomatocarpa diffusum       | Effit                  | RL           |
|           | 28 | Vanda helvola              | Effit                  | RL           |
|           | 29 | Mikropera pallida          | Effit                  | BT           |
|           | 30 | Mikropera sp               | Effit                  | BT           |
| Bulbophyllum | 31   | Bulbophyllum biflorum    | Effit                  | BT           |
|           | 32 | Bulbophyllum vaginatum     | Effit                  | BT           |
|           | 33 | Bulbophyllum lobby         | Effit                  | RL           |
| Cylindrobus | 34  | Cylindrolobus rigidus Blume | Effit                  | RL           |

Information: BT= Central Bengkulu, KPH = Kepahiang, RL = Rejang Lebong, LB= Lebong
The functional roots are dangling, while the roots that stick to the media (substrate) only function as an adhesive root, namely to hold the plant in its position [8]. The observation results showed that the host trees which have a rough surface of the bark are the places where the efifit orchids attach. Fardhani et al [9] suggest that tree species with these characteristics affect water and nutrient storage. Furthermore, the identification results (Table 2) showed that orchids have two types of growth, monopodial (5.8%) and sympodial (94.12%).

According to Rosanti [10] monopodial orchids are orchids that have a main stem that continues to grow upward (vertically) indefinitely. Leaves will increase steadily from the tip of the stem throughout its life. This species is devoid of rhizomes and pseudobulbs, and usually grows aerial roots along the length of the stem. Flower stalk grows from the side of the stem (axillary). If the tip of the stem is damaged by rot or cut / cut, a new stem will grow from the side of the old stem and leaves will grow from the new stem. Symподial orchids are orchids that have a main stem that is composed of annual segments. This type of orchid has a pseudobulb stem (pseudobulb). The growth of the ends of the stems is limited, stem growth will stop when the upward growth has been maximized. A new stem emerges from the base of the previous main stem.

Based on the observations obtained 15 genera consisting of 34 species. The orchids found have their own unique character, starting from the shape of sepals, petals, labellum and different colors. Efifit orchids have deep roots and hang in the air. The roots attach to both living and dead trees and have a rough surface [11].

| No | Type | Growth Patterns | Type of roots | Pseudobulb | Stem |
|----|------|----------------|---------------|------------|------|
| 1  | Arundina Graminifolia | Sympodial | Terrestrial | none/- | Reed, segmented |
| 2  | Phaius tankervilleae | Sympodial | Terrestrial | There are, small, ovoid shapes | Round |
| 3  | Spathoglottis plicata | Sympodial | Terrestrial | There, small, purple | Round |
| 4  | Grammathophyllum speciosum | Sympodial | Sticky roots | None | Round, segmented |
| 5  | Grammathophyllum stapeliflorum | Sympodial | Sticky roots | There, oblong and groove, long 11.66±0.58 cm width 4.83±0.29 cm | None |
| 6  | Agrostophyllum stipulatum | Sympodial | Sticky roots | None | Stems are very small, elliptical |
| 7  | Agrostophyllum majus | Sympodial | Sticky roots | None | Flat, leaf-covered sections |
| 8  | Agrostophyllum acuminatum | Sympodial | Sticky roots | None | Flat, leaf-covered sections |
| 9  | Cymbidium Finlaysonianum | Sympodial | Sticky roots | There, small | Flat covered with leaves |
| 10 | Cymbidium aloifolium | Sympodial | Sticky roots | There, small | Flat covered with leaves |
| 11 | Cologyne pandurata | Sympodial | Sticky roots | there, oval, flat, vertical grooved, 10.95±2.19 cm long, 4.25±0.23± cm width and thick 18.15±3.80 mm | None |
| 12 | Cologyne pulverula | Sympodial | Sticky roots | There shape is a vertical grooved javelin, 10.95 cm±2.19 cm long, 2.17±0.72 cm wide and 2.03±0.28 cm thick | None |
| No. | Species                      | Type             | Root Description                                      | Notes                                      |
|-----|------------------------------|------------------|------------------------------------------------------|--------------------------------------------|
| 13  | **Cologyne Prasina**         | Sympodial        | Stycky roots ovate, grooved vertically, height 6.57±0.77 cm, width 4.52±0.99 cm | None                                       |
| 14  | **Cologyne speciosa**        | Sympodial        | Stycky roots ovate, grooved vertically, height 3.65±0.07 cm, width 2.03±0.3 cm | None                                       |
| 15  | **Pholidota imbricate**      | Sympodial        | Stycky roots ovate, grooved, height 5.5 cm            | None                                       |
| 16  | **Apendicula**               | Sympodial        | Stycky roots none                                    | Small, round shape,                        |
| 17  | **Aporum Indivisum Blume**   | Sympodial        | Stycky roots none                                    | Does not appear to be covered with leaves  |
| 18  | **Dendrobium uncatum**       | Sympodial        | Stycky roots none                                    | Does not appear to be covered with leaves  |
| 19  | **Dendrobium leonis**        | Sympodial        | Stycky roots none                                    | Flat covered with leaves                   |
| 20  | **Aporum acinaciforme**      | Sympodial        | Stycky roots none                                    | Flat, yellowish green color               |
| 21  | **Oberonia anceps**          | Sympodial        | Stycky roots none                                    | Flat covered with leaves                   |
| 22  | **Dendrobium crumentum**     | Sympodial        | Stycky roots None                                    | Round, green                              |
| 23  | **Dendrobium annae**         | Sympodial        | Stycky roots None                                    | Round                                     |
| 24  | **Dendrobium linearfolium**  | Sympodial        | Stycky roots None                                    | Round and smooth                           |
| 25  | **Acriopsis lilifolia**      | Sympodial        | Stycky roots None                                    | None                                       |
| 26  | **Acriopsis javanica Reinw** | Sympodial        | Stycky roots None                                    | None                                       |
| 27  | **Pomatocarpa diffisum**     | Monopodial       | Stycky roots None                                    | Round, covered in midrib                   |
| 28  | **Vanda helvola**            | Monopodial       | Stycky roots None                                    | Round, covered in midrib                   |
| 29  | **Mikropera pallida**        | Monopodial       | Stycky roots None                                    | Round, covered in midrib                   |
| 30  | **Mikropera sp**             | Monopodial       | Stycky roots None                                    | Round, covered in midrib                   |
| 31  | **Balbophillum biflorum**    | Sympodial        | Stycky roots None                                    | None                                       |
| 32  | **Balbophyllum vaginatum**   | Sympodial        | Stycky roots None                                    | None                                       |
| 33  | **Balbophyllum lobby**       | Sympodial        | Stycky roots None                                    | None                                       |
| 34  | **Cylindrolobus rigidus Blume** | Sympodial  | Stycky roots None                                    | Round, segmented                           |
Table 3. Morphological Characters of Leaves and Flowers

| No | Type                      | Leaves                                                                 | Flower                                                                 |
|----|---------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1  | Arundina Graminifolia     | consists of strands and leaf midrib. Needle shape, acuminate tip, flat edge. | At the end, single sometimes branched, there are 3 colors (purple, light purple, white), wavy lip and yellow in the middle |
| 2  | Phaius tankervilleae      | Lanset, grooved, flat edge                                             | The base of the axillary leaves, bunches, stars, yellow upper surface, white lower surface, red lip |
| 3  | Spathoglottis plicata     | Lanset, grooved, flat edge                                             | Base of stems, bunches, stars, purple                                 |
| 4  | Grammathophyllum speciosum| Ensiform (like a sword). Flat edges                                    | he sides of the pseudobulb, bore, yellow with mottled spots           |
| 5  | Grammathophyllum stapeliiflorum | Oval, thick, flat edge                                                | On the side / base of the pseudobulb strands, reddish brown color |
| 6  | Agrostophyllum stipulatum | Rounded elongated flat edge, split tip, where the leaves are opposite and alternate, 1.3 cm long, 0.5 cm wide. | Flowers on small ends are yellow or white                             |
| 7  | Agrostophyllum majus      | Lanceolate shape, long, smooth surface, flat edge                       | Flower at the end of the head shape. One hump is arranged in small yellow or white flowers |
| 8  | Agrostophyllum Acuminatum | Lancet form                                                             | Flower at the end of the head shape. One hump is arranged in small yellow or white flowers |
| 9  | Cymbidium Finlaysonianum  | Ribbon shape, straight, hard, emerginate tip 33.18 ± 9.35 cm, width 1.25 ± 0.24 cm | Forms of strands, grows at the base of the stem, flowers diligently |
| No. | Species                     | Leaf Description                                                                 | Flower Description                                                                 |
|-----|----------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 10  | Cymbidium aloifolium       | For ribbon, straight, hard, emerginate tip 33.18 ± 9.35 cm, width 1.25 ± 0.24 cm | Forms of strands, growing at the base of the stem, aromatic                           |
| 11  | Cologyne pandurata         | The leaves attached to the pseudobulb are green                                 | The orchid flower appears in basal (base / side pseudobulb) strand type, star shape |
| 12  | Cologyne pulverula         | The orchid leaves attached to the pseudobulb are green                           | The orchid flower appears at the base / side of the pseudobulb. Shaped like strands. Arranged a series of intermittent flowers totaling 18 pieces |
| 13  | Cologyne Prasina           | Oblanceolate leaf form acute leaf tip, petiole length 3.5 ± 0.41 cm, leaf length 22.00 ± 1.68 cm, leaf width 5.50 ± 0.66 cm | The orchid flower appears at the end of the pseudobulb. Flowers are shaped like yellow stars |
| 14  | Cologyne speciosa          | The orchid leaves attached to the green pseudobulb. The number of leaves attached to the bulb is one sheet | The orchid flower appears at the end of the pseudobulb. Flower shape like star, pink color |
| 15  | Pholidota imbricatcoreus   | The leaves attached to the pseudobulb are one sheet. 27.52 ± 1.35 cm long, 6.42 ± 0.51 cm wide coreaceus (thick and stiff leaves), elliptic leaf shape | The orchid flower appears at the end of the pseudobulb. Shaped like strands, yellow color |
| 16  | Apendicula                 | Oval, flat edge, blunt tip, opposite side of each other, ± 4.2 cm long, 2.1 cm wide, 0.5 mm thick. | Receme, grow tip (terminal), small size, no aroma.                                     |
| 17  | Aporum Indivisum Blume/Dendrobium Smithianum | Leaves like saw blades, fleshy, hard | A single flower, small, growing in the axillary of the leaves. Yellow color and red stripe |
| No. | Species               | Description                                                                 | Flower Details                                                                 |
|-----|-----------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 18  | Dendrobium uncatum    | The leaves are like saw blades, fleshy, hard opposite and alternate         | A single flower, growing at the tip, small, growing in the axillary of the leaves and the tip of the stem. Length 1.15 ± 0.07 cm reddish color |
| 19  | Dendrobium leonis     | The leaves are like saw blades and are fleshy opposite                      | Single flower, small, measuring 1.2 cm long and 0.9 cm wide                   |
| 20  | Aporum acinaciforme   | Leaves like saw blades, fleshy, hard                                       | Receme flowers, small, grow at the end of the stem                             |
| 21  | Oberonia aniceps      | Leaves like saw blades, fleshy, hard                                       | The receme flower, small, grows at the end of the stem                         |
| 22  | Dendrobium crumentum  | Lanceolate leaves, slightly notched tip, 6.72 ± 0.70 cm long, 2.20 ± 0.20 cm wide | Single flower, white, star shape, fragrant                                    |
| 23  | Dendrobium annae      | Leaf ellipse, pointed tip, alternating. Length 5.92 ± 1.51 cm, width 2.0 ± 0.14 cm, distance between leaves 2.8 ± 0.17 cm | Flowers in bunches, sometimes single, white in color and with spots on the lip |
| 24  | Dendrobium linearfolium| Leaves linear, smooth. 3-5 cm long, 0.5-0.75 cm wide                     | Single, white, lip has a yellow color                                          |
| 25  | Acriopsis liliifolia  | Ribbon, flat edge, blunt leaf tip,                                         | Flower bunches, pseudobulb side yellow                                       |
| 26  | Acriopsis javanica    | Ribbon, flat edge, blunt leaf tip,                                         | Flowers in bunches, growing from the side of the purple bulb                  |
| Number | Species                  | Leaf Description                                                                 | Flower Description                                                                                                                                 |
|--------|--------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 27     | Pomatocarpa diffusum     | Ribbons, flat edges, split leaf tips                                             | Flowers grow in the armpits, bunches, yellow in color                                                                                                 |
| 28     | Vanda helvola            | Ribbons, flat edges, split leaf tips                                             | Flowers grow in axillary, bunches, yellow, and brown                                                                                                 |
| 29     | Mikropera pallida        | Pita, tepi rata                                                                    | Flowers are located in the axillary (side / between two axillary leaves), flowering type racemosa (bunch)                                              |
| 30     | Mikropera sp             | Green oblong shape, the tip of the leaf is retuse (blunt / slightly notched)      | Flowering is located in the axillary (side / between the two axillary leaves) racemose (bunch) flowering type. White yellow flower color           |
| 31     | Bulbophillum biflorum    | Single leaf, growing at the tip of the pseudobulb, oblong shape, split tip, flat edge | Flowers grow from the side of the pseudobulb, purple grooved                                                                                          |
| 32     | Bulbophyllum vaginatum   | Single leaf, fleshy, hard growing at the tip of the pseudobulb, oblong shape, split tip, flat edge | Flowers growing from the side of the pseudobulb are yellow long fur                                                                                 |
| 33     | Bulbophyllum lobby       | Single leaf, grows at the tip of the bulb, obovate shape, flat edge, length 22.30 ± 2.21 cm, width 7.07 ± 0.95 | Single flower, appearing from the side of the pseudobulb, like a star, yellow-brown color                                                               |
| 34     | Cylindrolobus rigidus Blume | The leaves are alternating, the distance between the leaves is 1.37 ± 0.15 cm, the leaves are spiky | Single flowers grow on the sides or between the armpits of white and yellow leaves                                                                     |
Tabel 3. discovered that the orchid flower has a very large variety of flowers. A unique and attractive form is a genetic asset that can provide economic value if managed properly [12]

4. Conclusion
There is a diversity of growth types, bulb shape, shape, size, leaf and flower shape and color.

Acknowledgement
Gratitude to BPTP Bengkulu for providing funds through the 2018 DIPA activities. The same thanks and appreciation are also addressed to all team who have helped during this research until its completion.

References
[1] Zhang S, Yang Y, Li J, Qin J, Zhang W, Huang W and Hu H 2018 *Plant Divers.* **40** 196–208
[2] Puspitaningtyas D M 2020 *Biodiversitas J. Biol. Divers.* **21** 5455–64
[3] Nursanti, Wulan C and Anggundary E 2020 *J. Silva Trop.* **4** 280–91
[4] Alzate-Q N F, García-Franco J G, Flores-Palacios A, Krömer T and Laborde J 2019 *Flora Morphol. Distrib. Funct. Ecol. Plants* **260** 151463
[5] Surakusumah W 2013 Perubahan Iklim dan Pengaruhnya Terhadap Keanekaragaman Hayati *Makal. Perubahan Lingkung. Glob.* 24
[6] Rahyu Ningsih H N, Kartikawati S M and Muflihati M 2020 *J. TENGKAWANG* **10** 24–33
[7] Tagentju R J, Toknok B and Korja I N 2020 *Jurnal Warta Rimba* **8** 58–63
[8] Purnama I, Rusmiyanto E, Wardoyo P and Linda R 2016 *Protobiont* **5** 1–10
[9] Fardhani I, Torimaru T and Kisanuki H 2020 *Biodiversitas* **21** 290–8
[10] Rosanti D 2018 *Sainmatika J. Ilm. Mat. dan Ilmu Pengetah. Alam* **15** 30
[11] Hauber F, Konrad W and Roth-Nebelsick A 2020 *Appl. Phys. A Mater. Sci. Process.* **126** 1–17
[12] Demena M, Raunsay E K and Agustini V 2020 *Jurnal Kehutanan Papuasia* **6** 62–70