



IDENTIFICATION OF MYCOHETEROTROPHIC PLANTS (Burmanniaceae, Orchidaceae, Polygalaceae, Tiuridaceae) IN NORTH SUMATRA, INDONESIA

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ABSTRACT

The majority of mycoheterotrophic herbs live in shady and humid forest. Therefore, the types of mycoheterotrophic plant are very abundant in tropical areas. One of the areas in Indonesia with the tropics is North Sumatera province. Unfortunately, the information about the species of mycoheterotrophic in North Sumatera is still limited. The objective of the research was to figure out the types of mycoheterotrophic plants in North Sumatera. The study was conducted in August until October 2019 in several areas of the Natural Resources Conservation Hall (BBKSDA) of North Sumatera province, the nature Reserve and nature Park. The research sites covered Tinggi Raja Nature Reserve, Dolok Sibual-Buali Nature Reserve, Sibolangit Tourist Park and Sicike-Cike Natural Park. In conducting sampling, the method used was through exploration or cruising method. The list of mycoheterotrophic plant species presented in this study consisted of their scientific names, synonyms, descriptions, distributions, and ecological information. A total of 9 species of mycoheterotrophic plants (4 families) in Sumatra have been found. As for the family Burmanniaceae, there are three species *Burmattia championii*, *Burmattia lutescens*, *Gymnosiphon aphyllus*. On the other hand, as for the Orchidaceae, there are 4 species, such as *Didymoplexis pallens*, *Eulophia zollingeri*, *Galeola lindleyana*, *Gastrodia verrucosa* while for the Poligalaceae and Tiuridaceae family, simply one type is found: *Epirixanthes elongata* and *Sciaphila Secundiflora*, respectively.

Keyword: Mycoheterotrophic, Burmanniaceae, Orchidaceae, Poligalaceae, Tiuridaceae

Introduction

Mycoheterotrophic plants were initially found in 1866 by Odoardo Beccari, an Italian botanist at Mount Matang, Sarawak, Malaysia (Razka 2018) and were introduced by Leake (1994). The plants were known as saprophyte but they were turned into mycoheterotrophic because the meaning of saprophytes was considered less appropriate and often interpreted incorrectly (Leake 2005). Grouping the plants is on the basis of the loss of their ability to perform photosynthesis so as to acquire nutrients from soil, they need to associate with mycorrhizal. Thus, their growth is highly dependent on the rainy season which can affect the condition of light intensity, temperature, pH and soil humidity of their habitat. The condition also affects the emergence of mycoheterotrophic plants (Leake 2005). A specific morphological

characteristic that can be observed is that they possess no green leaves (Muhaimin *et al.* 2017; Leake 1994; Merckx *et al.* 2013). In some recent literature, Mycoheterotrophic plants can be also called holomycotrophic plants (Campbell, 2014).

Currently, Mycoheterotrophic has 17 families, 101 genera and 880 species (Merckx *et al.* 2013) that consists of Pteridophyta and Spermatophyta. The nail plants that associate with fungi come from the families of Lycopodiaceae, Ophioglossaceae and Psilotaceae (Muhaimin *et al.* 2017). Flowering Plants (Spermatophyta) consist of ten families with 89 genera. The Monochotil is Burmanniaceae, Thismiaceae, Corsiaceae, Iridaceae, Orchidaceae, Peterosoviaceae, and Tiuridaceae. The Dichotil is Ericaceae, Gentianaceae and Polygalaceae. The majority of mycoheterotrophic plants live in a shady and humid forest habitat.

Therefore, the types of mycoheterotrophic are highly abundant in tropical areas (Leake 1994).

One of the areas with the tropics is North Sumatra province. North Sumatra is located at 1 °-4 ° N and 98 °-100 ° E, with total area of 7,981.23 km². The boundaries of North Sumatra province are Aceh province (north), Straits of Malacca (east), Riau Province and West Sumatra (south) as well as Aceh Province and Indonesian Ocean (west). North Sumatra has a tropical wet climate with average rainfall ranging from 800-4,000 mm per year. The average sunlight illumination intensity is 43% while air humidity varies between 78%-91% (BPS 2013).

Forest is a unity of ecosystem in the form of land that contains natural resources dominated by trees in the natural fellowship of the environment where one with the other cannot be separated. Forest areas are particular territories designated and/or set by the Government to be retained as a permanent forest. In North Sumatra, the area covers 3,742,120 ha or 52.20% of the entire area of the province which has an area of 7,168,000 ha (Law No. 41 of 1999 concerning Forestry). The whole forest is a conservation area. Conservation forests in Sumatra are unique to the lowlands, highlands, and mountains. The area which become the site of the present research is that at a height of 360 - 1,500 meters above sea level (masl).

Unfortunately, the information about the species of mycoheterotrophic plants in North Sumatra is limited. The present research could be an initial effort to generate new knowledge and provide important information about mycoheterotrophic species which can benefit many

parties such as researchers, students and lecturers who are interested in the study of mycoheterotrophic.

Materials And Methods

This present study was conducted in August until October 2019 in several areas of the Natural Resources Conservation Hall (BBKSDA) of North Sumatra province, the nature Reserve and nature Park. The research sites covered Tinggi Raja Nature Reserve, Dolok Sibual-Buali Nature Reserve, Sibolangit Tourist Park and Sicike-Cike Natural Park. The sites were selected because they have a forest function that is not disturbed from land conversion and illegal logging. They also have place for mycoheterotrophic to live in, which is a tree, that forms a canopy so that it has a closed and damp land. This refers to the habitat of mycoheterotrophic plants that are not exposed to sunlight.

In conducting sampling, the method used was through exploration. Each of the samples found at the given sites was photographed and the plants were taken for herbarium and identification purposes. The identification of mycoheterotrophic plants based on several morphological features such as habitus, stems, flowers, roots and matched using literature.

The list of mycoheterotrophic species presented in the present study consists of scientific names, synonyms, descriptions, distributions, ecological information. The species are categorized as mikohototrophic that can be fully characterized based on the absence of green leaves (Leake 1994; Merckx *et al.* 2013)

Tabel 1. Sampling Coordinates

| No | Location | Coordinate | |
|----|-----------------------------------|----------------|-----------------|
| 1. | Tinggi Raja Nature Reserve | N 03°08'35.4" | E 098°47'25.9" |
| 2. | Dolok Sibual-Buali Nature Reserve | N 01°32'33.46" | E 099°16'33.37" |
| 3. | Sibolangit Tourist Park | N 03°19'54.0" | E 098°35'04.3" |
| 4. | Sicike-Cike Natural Park | N 02°38'44.60" | E 098°22'49.35" |



Figure 1. Locations Map of Mycoheterotrophic Plant Sampling in North Sumatra

Result And Discussion

Results of the field explorations found nine species of mycoheterotrophic plants (4 families, 8 genera); namely, Burmaniaceae, Orchidaceae, Polygalaceae, dan Tiuridaceae. the Burmaniaceae

family has one species which is *Burmannia lutescens*. As for the Orchidaceae, there are two species: *Epipogium roseum* and *Gastrodia siamensis* Rolfe ex Downie (Table 2)

Table 2. Mycoheterotrophic plants found in North Sumatra

| Family | No | Species |
|--------------|----|-------------------------------|
| Burmaniaceae | 1 | <i>Burmannia championii</i> |
| | 2 | <i>Burmannia lutescens</i> |
| | 3 | <i>Gymnosiphon aphyllus</i> |
| Orchidaceae | 4 | <i>Didymoplexis pallens</i> |
| | 5 | <i>Eulophia zollingeri</i> |
| | 6 | <i>Galeola lindleyana</i> |
| | 7 | <i>Gastrodia verrucosa</i> |
| Polygalaceae | 8 | <i>Epirixanthes elongata</i> |
| Tiuridaceae | 9 | <i>Sciaphila secundiflora</i> |

Burmaniaceae

1. *Burmannia championii* Thwaites

Synonym: *Burmannia chionantha* (Schltr.), *Burmannia dalzielii* (Rendle), *Burmannia hunanensis* (K.M.Liu & C.L.Long), *Burmannia japonica* (Maxim. ex Matsum.), *Burmannia tuberosa* (Becc.)

The plant grows on sloping land under the canopy with sandy soil. They are simply found close to the river in Dolok Tinggi Raja Nature Reserve. Their small body is white with a height reaching 12 cm. They are unbranched, and have round stem with a diameter of 2.5 mm. Each individual consists of 3-8 flowers.

Location found: Dolok Tinggi Raja Nature Reserve

Distribution: China, Korea, Japan, India, Sri Lanka, Vietnam, Taiwan, Thailand, Malaysian Penynsula, New Guinea, Borneo, Java and Sumatra.

Ecological Information: they grow under the canopy of giant trees.

2. *Burmannia lutescens* Becc.

Synonym: *Burmannia candida* (Blume) Engl. [Illegitimate], *Burmannia gjellerupii* J.J.Sm., *Burmannia gonyantha* Hochr., *Burmannia novae-hiberniae* Schltr., *Burmannia papillosa* Stapf, *Burmannia tridentata* Becc., *Gonianthes candida* Blume.

These plants form colonies under the Rasamala (*Altingia excelsa*) tree, low to high forest on slopes with closed canopies. The plants live between rotten

leaves and symbiosis with fungi (hyphae). Their canopy is slightly open and the soil is not too humid. They are found in the Bukit Barisan Great Forest Park, Dolok Tinggi Raja Nature Reserve, and Dolok Sibual-buali Nature Reserve. The shape is monocot and herbaceous with a height of 9.2-14.9 cm, segmented where space between segments is 11.5 - 23.5 mm. The stem is white (transparent), square, 0.7 - 1.3 mm in diameter, and has no leaves. The fiber roots are yellow, and generally each stem has three flowers. The flower stems are spiral shaped. The centerpiece of the shortest flower stems with a length of stems is between 0.4 until 24.3 mm, in the form of a triangle, and hermaphrodite. The sari box is at the top of the flower, yellow, and the pistil is at the base of the flower. Their fruits consist of small seeds. Based on research Nuraliev et al (2018), *Burmanna lutescens* was also found in Vietnam and became a new record.

Location: Cagar Alam Dolok Tinggi Raja

Distribution : Bismarck Island, Malaysian Penynsula, Borneo, Sumatera, Sulawesi dan New Guinea (Nuraliev et al, 2018).

Ecology : Under the canopy of giant trees, litter, moist soil that is usually a mixture of sand, and at an altitude of 434 - 1,500 masl.

3. *Gymnosiphon aphyllus* Blume

Synonym: *Gymnosiphon pedicellatus* Schltr., *Gymnosiphon nanus* (Fukuy. & T.Suzuki) Tuyama, *Gymnosiphon borneensis* Becc., *Burmanna nana* Fukuy. & T.Suzuki

The height is 104 - 114 mm. This plant is parasitic on fungus. The stem is reddish purple and its branches are near the flower. The stem is round with a diameter of 0.6 to 0.7 mm and a smooth texture. The flowers are purple with a length of 3.9 - 7.2 mm. Its roots are fiber.

Location: Dolok Tinggi Raja Nature Reserve

Distribution: Taiwan, Thailand, Malaysian Penynsula, Borneo, Sulawesi, Sumatra, Java and Nusa Tenggara Island.

Ecology: It grows on moist land, sandy soils, under the canopy of giant trees among the Banir-Banir. It is found on lowland forests at a height of 360 masl.

Orchidaceae

4. *Didymoplexis pallens* Griff.

Synonym: *Apetalon minutum* Wight, *Arethusa ecristata* Griff., *Cheirostylis kanarensis* Blatt. & McCann, *Didymoplexis brevipes* Ohwi, *Didymoplexis subcampanulata* Hayata, *Didymoplexis sylvatica* (Blume) Garay, *Epiphanes pallens* (Griff.) Rchb.f., *Gastrodia pallens* (Griff.) F.Muell.

Leucorchis minuta (Wight) Blume,
Leucorchis sylvatica Blume.

The species is saprophyte with height of 9-14 cm. The stem is round with a diameter of 1.4 - 1.8 mm near the flower. The surface is glossy and slippery. It is not branched; the flowers appear in its segments. Its flowers can reach 20 items, but only one or two bloom at almost the same time. The flowers are white yet the bloom is not perfect. The stems are round with a length of 4-6 mm, but they will elongate when they turn into fruit. The sepal's length is 1 cm, petal 0.8 cm. Its lips erect and round. Location found: Sicike-cike Nature Park

Distribution: India, Southeast Asia, northern Australia and the Pacific Islands.

Ecological Information: the species are around rotting trees with thick topsoil, and also around rotting wood. Humus is thick and moist, and between leaf litter.

5. *Eulophia zollingeri* (Rchb. f) J.J. Sm.

Synonym: *Cyrtopera formosana* Rolfe, *Cyrtopera papuana* Ridl., *Cyrtopera rufa* Thwaites, *Cyrtopera sanguinea* Lindl., *Eulophia carrii* C.T.White, *Eulophia formosana* (Rolfe) Rolfe, *Eulophia macrorhiza* Blume, *Graphorchis macrorhiza* (Blume) Kuntze.

Commonly, the plant grows on grasslands or at forest edges. However, this type of orchids is found in Sibolangit Tourist Park. Its body is reddish brown with a height of 64 cm. It has pseudobulbo embedded in the ground. Its stem is upright round. Its flowers are compound amounted to 15 - 20 yet possess no leaves. The flowers are reddish brown. The stem's length is 2.5 until 4.5 cm. Its sepal lanset is 1.6 cm long. Its petal can elongate until 1.5 cm. Its lips have lobe 3.

Location: Sibolangit Tourist Park

Distribution: India, Southeast Asia, New Guinea and northern Australia.

Ecology : Under the canopy on the observation track, at cliff edges and with forest canopy cover at a height of 513 masl.

6. *Galeola lindleyana* Rchb.f.

Synonym: *Cyrtosia lindleyana* Hook.f. & Thomson.

The species' rhizomes are red on the ground or crawl close to weathered trees. The stem is woody with a height up to 2 meters. They are coated by brown tricoma. They are branched near flowering. Their flowers are yellow with a length of 2.5 cm yet the bloom is not perfect. The sepal is egg round, but widened at the base of the flower. The fruits are brown capsule-shaped and coated by tricoma.

When the fruits are about to break, the seeds will be swept away by the wind.

Location found: Sicike-cike Nature Park

Distribution: India and Sumatra. In North Sumatra, the species have been reported in Merek, Karo, and Sibira.

Ecological Information: they live on the trees that have decomposed on open land, also on trees that have decomposed into a growing place. The saprophytes are symbiotic with fungi. If you would like to see them, you may visit the forests that have been cut down at an altitude of 1,400 - 1,600 masl in the area of Dairi Regency.

7. *Gastrodia verrucosa* Bl.

Synonym: *Gastrodia holttumii* Carr

The species are Herbaceous plants with a height of 6-17 cm. The stem is round and black but sometimes lighter with brown color. They always have gray spots and a smooth surface. They are 1.6 - 3.1 mm in diameter and segmented. They possess a hook-shaped handle. Their flowers are usually amount to 1-3 and are blackish brown. They also have prominent gray spots sometimes are appearing white. The flowers are not perfect in bloom with a triangle shape. The stems' length is 9-12 mm, and the color is brown at the base and black towards the base of the flower. The length of the flower is 12.2 - 14.9 mm with diameter 8.3 - 11.7 mm. The sepal is orange and can be seen inside the flower.

Distribution: In North Sumatra only found in the Sicike-cike Nature Park.
Location found: Sicike-cike Nature Park

Ecological Information: they live between tree roots, thick topsoil with litter heaps. They were found at an altitude of 1,300 - 1,400 masl. The species are tucked between the roots of the sampinur strap tree (*Dacrydium elatum*) and meang (*Palaquium gutta*). This typical orchid known as the ghost orchid is symbiotic with mycorrhiza embedded in the leaf litter that has started to rot. They grow on land with high humidity more than 80%, thick topsoil with a pH of 6.2. they are solitary and some are in groups.

Polygalaceae

8. *Epirixanthes elongata* Bl.

Synonym: *Epirixanthes aphylla* (Griff.) Merr.,
Epirixanthes linearis Blume,
Epirixanthes tenella Hook.f.

The plant is a fungus parasite on trees that are already dead and buried in the soil. It is dicotyledonous and herbaceous, and grows in groups on rotting sandy soil. The stem's height is 10.2 - 12.1 cm with a diameter of 1.1 - 1.3 mm, round, red and embedded in white soil. Its handle is very small and red, and not segmented. The flowers are compound and white. The length of the flower is 1.6 - 1.9 mm. The number of its flowers is 25 to 44 in each branch. Its taproots are white.

Location: found in Sibolangit Nature Park and Sibual-buali Dolok Nature Reserve
Distribution: India, China, Vietnam, Laos, Thailand, Malaysian Peninsula, Borneo, Sumatra, Java and Maluku.

Ecological Information: they grow on weathered trees that have been buried in sandy soil at an altitude of 360-500 masl.

9. *Sciaphila secundiflora* Thwaites ex Benth.

Synonym: *Sciaphila asterias* Ridl.,
Sciaphila brachystyla Schltr.,
Sciaphila inornata Petch,
Sciaphila maboroensis Schltr.,
Sciaphila macra K.Schum. & Schltr.,
Sciaphila major Becc., *Sciaphila megastyla* Fukuy. & T.Suzuki,
Sciaphila monticola K.Schum. & Schltr.,
Sciaphila papuana Becc., *Sciaphila pilulifera* Schltr.,
Sciaphila sumatrana Becc.

The species are saprophyte and herbaceous. Their stem is sometimes branched from the bottom. The stem is only 5 cm high, round and slippery, 0.2 mm in diameter. The stem's color is brown and upright. In each segment, there are purplish red leaves, 3 - 8 mm long. When they were found, the species simply have red male flowers.

Location found: Sibual-buali Dolok Nature Reserve, North Sumatra

Distribution: Korea, Japan, China, Taiwan, Thailand, Sri Lanka, Malaysia, Borneo, Sumatra, New Guinea to the Solomon Islands. In North Sumatra, it is found on Mount Sibual-buali on a sloping land, under a canopy with thick litter.

Ecological information: Sloping land, under the canopy, thick litter.

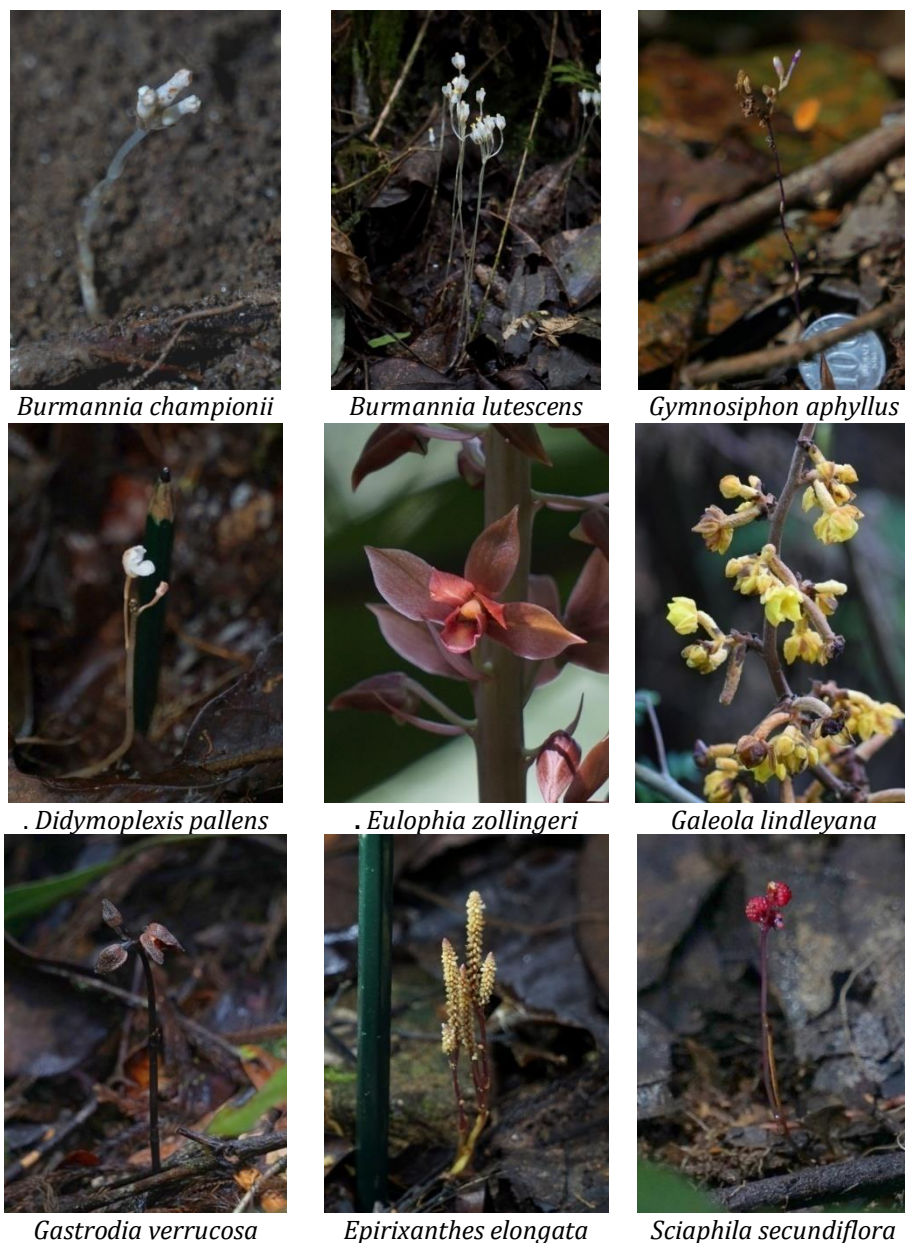


Figure 2. Several Mycoheterotrophic Plants Found in North Sumatra

Conclusion

Based on the research findings, it can be concluded that 9 species of mycoheterotrophic plants (4 families, 8 genus) in Sumatra are found. They are Burmanniaceae family with *Burmannia lutescens* species, and Orchidaceae family with *Epipogium roseum* and *Gastrodia siamensis* species. These three species are new records of mycoheterotrophic plants in Bukit Barisan Forest Park, North Sumatra, Indonesia. As for the family Burmanniaceae, there are three species are discovered: *Burmannia championii*, *Burmannia lutescens*, *Gymnosiphon aphyllus*. On the other hand, as for the Orchidaceae, there are 4 species are discovered; namely, *Didymoplexis pallens*, *Eulophia zollingeri*, *Galeola lindleyana*, and *Gastrodia*

verrucosa whereas for the Poligalaceae and Tiuridaceae family, simply one type is found: *Epirixanthes elongata* and *Sciaphila Secundiflora*, respectively.

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