



Study of Mistletoe in Joben Resort Forest Mount Rinjani Lombok

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Abstract

Mistletoes are one group of hemiparasite plants, including the Lorantaceae family that have potential as medicinal. These hemiparasite plants can attack flowering plant (Magnoliophyta) and non-flowering plant (Pinophyta), especially on the main stems, branches and twigs. The objective of this research is to identify the species of mistletoe and its hosts, make identification key, descriptions, and to make a distribution map of mistletoe in Joben Resort forest south of Mount Rinjani Lombok. This study is descriptive explorative research with three kinds of collecting sample methods i.e exploration, continuous strip sampling, and delimitation method. The research found five species of mistletoes are included in three genera i.e *Amyema cuernosensis*, *Amyema enneantha*, *Amyema tristis*, *Macrosolen retusus* and *Scurrula arthropurpurea*. These five kinds of mistletoe are associated with 23 hosts species of plants, 18 genera from 13 families. The most favorite host of these mistletoes is *Ficus septica*, and the most aggressive mistletoe is *Scurrula arthropurpurea*. The important finding of the research is finding new species or new record of mistletoes. The benefit of these new record or new species is providing new material of new medicinal for treating some diseases such as various cancers.

How to Cite

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INTRODUCTION

Mistletoe is one of hemiparasite in Loranthaceae family. It usually attacks shrubs or trees especially on the trunks and branches. These mistletoes will creep the host plants by inserting their haustoria into the host branches or with internal or external epicortical runner (Vidal-Russell & Nickrent, 2008a). Since the growth is ruined, some trees will probably wither and die. Loranthaceae family consist of 73 genera and 950 species. Most of them live in tropical, subtropical or temperate climate. Malesia is reported to have 23 genera and 193 species of Loranthaceae family (Barlow, 1997, Vidal-Russell & Nickrent, 2008b).

Indonesia reportedly has 174 species of mistletoes that consists of 26 genera. There are 38 species of mistletoe (Loranthaceae family) in Java. The number of species found in West Java, namely 29 species (Sunaryo, 2008), in East Java and Central Java respectively represent 19 and 15 species of mistletoes (Sunaryo, et al., 2010 and Yunita, 2014). In Bali, there are four species of Loranthaceae found in Eka Karya Botanical Garden i.e. *Dendrophthoe pentandra*, *Helixanthera cylindrica*, *Scurrula atropurpurea*, and *Scurrula parasitica*. Viscaceae family consists of two species i.e. of *Viscum articulatum* and *Viscum ovalifolium* which are found in Purwodadi (Sunaryo, et al., 2007).

Mistletoe indicated threatening to the citrus industry in Ghana. A drastic drop in yield of the citrus plants when attacked by the mistletoe (95%), poor growth of the citrus plants (65%) and mortality when severely infected (55%). Mistletoe also give infestation results in yield loss averaging between 5% and 85.5%. It agrees with the findings of studies on the prevalence of mistletoe on the citrus orchards in the Eastern Region of Ghana and in Sudan. It was reported that mistletoe infestation causes drastic growth retardation, yield loss and subsequent killing of the citrus plants (Asare-Bediako, et al., 2013).

Mistletoe is not only known as a parasite which disturbs other plants but also as a potential medicine. Some research has been done on mistletoe of mango (*Dendrophthoe pentandra*) as the first step towards phytochemistry among other phytochemical studies to identify the content of the active compound. Based on the test known that the mango mistletoe contains flavonoids quercetin, meso-inositol, rutin, and tannins. The compounds are active as anticancer possibilities (Pramudanti et al., 2013).

Joben Resort forest area is located in the southern slope of Mount Rinjani Lombok. It is

rich of water resources. Its terrain and vegetation is a potential place to find mistletoes. Since each area is geographically different, the climate and the environment will also be different. It is very common to find many different kinds of mistletoes. Joben Resort forest area was divided into three areas, namely: 1. the edges of woods and trails tracking composed of secondary forests; 2. the middle section is composed of primary forest; 3. The top section (> 1750 m above sea level (asl.)) is composed of savanna.

The objective of this research is to determine the species of mistletoe, and their hosts, to make identification key, descriptions, and to make a mistletoe species distribution map in Joben Resort forest area which is located in the southern slope of Mount Rinjani Lombok.

METHODS

Mistletoe exploration in Joben Resort forest area which is located in the southern part of Mount Rinjani Lombok. The research was held on July-November 2016. The environmental data were recorded such as the habitat, air temperature, air moisture, altitudes, slopes, and coordinates position of mistletoes finding. Mistletoes specimens and their hosts were identified morphological features by using both keys and descriptions from various taxonomic literatures previously reported such as Backer & Bakh. f. (1965), Barlow (1929, 1991 and 1997), Denser (1935), Radford, et al. (1974) and URL: <http://theplantlist.org>.

The research was conducted using three kinds of collecting samples methods: exploration method (Rugayah, et al., 2004), continuous strip sampling method (Simon, 2007), and delineation method (Mulyaningsih, et al., 2014). The samples were taken by making five vertical lines in Joben Resort forest area in the southern slope of Mount Rinjani Lombok.

RESULTS AND DISCUSSION

The research found five species of mistletoes which were included in three genera i.e. *A. cuernensis*, *A. enneantha*, *A. tristis*, *M. retusus* and *S. atropurpurea*. Four species of mistletoes i.e. *Amyema enneantha*, *Amyema tristis*, *Macrosolen retusus* and *Scurrula atropurpurea* included new record of mistletoes that were found in Lombok island. These five species of mistletoes are associated to 23 plant species, 18 genera from 13 families.

Key identification of parasite plant

- 1a. Margin lamina sinuate, leaf and petiole tomentose *Scurrula artropurpurea*
- b. Margin lamina entire, leaf and petiole glabrous 2
- 2a. Haustoria gall external host stem tissues, stem flattened and widened at the end of the internodes..... *Macrosolen retusus*
- b. Haustoria gall internal host stem tissues, stem doesn't flattened and widened at the end of the internodes..... 3
- 3a. Trees tall <50 cm, lamina length <10 cm, lamina width <5 cm, petioles subsessile, *Amyema tristis*
- b. Trees tall >50 cm, lamina length >10 cm, lamina width >5 cm, petioles sessile..... 4
- 4a. Nodus swell forming stem knee, the amount of branching <5, leaves ternate, *Amyema enneantha*
- b. Nodus swell forming stem tumor, the amount of branching >5, leaves opposite, *Amyema cuernosensis*

Description Species of Mistletoe

1. *Scurrula artropurpurea* (Blume) Danser. Bull. Jard. Bot. Buitenzorg 111, 10 (1929) 349, 11 (1935) 429. New record based on: Danser (1929 and 1935), Barlow (1991 and 1997), Backer & Bakh. f. (1965), Pelser (2015) (Figure 1).

Aerial stem-parasitic shrubs, slender, drops, 50-150 cm tall, tomentose cream, with external gall and external runners epicortical. Adult stems cylindrical, tomentose cream, fissure, lenticell, young stems flattened at the end of internodes. Leaves alternate, opposite, subopposite; lamina papyraceous, dull, tomentose cream, polymorphic: rounded, obovate, elliptical: 5-13.2 cm length, 3-7.5 cm width; apex: rounded obtuse rarely acute; base: cuneate or oblique or obtuse; margin sinuate; venation reticulate, midrib and the laterals veins visible on both sides, 5-6 lateral veins per lamina; petiole 1-2 cm by 0.1 cm, green, dense tomentose cream. Inflorescences raceme axillary and at the nodes, 2-8 racemes per node, peduncle 0.2-0.3 cm by 0.05 cm, tomentose cream, 6-7 flowers per raceme; pedicel 0.5-0.8 cm by 0.1 cm, tomentose cream; Bracteole deltoid, tomentose cream, 1 at the tip of pedicel. Flowers tubulate, 1.5-2 cm length, 0.5 cm width, perianth gamosepalous, 4 merous; calyx lobe rounded, tomentose cream; corolla green: 1.2-1.5 cm by 0.5 cm, lobe oblanceolate, 0.5-0.8 cm by 0.5 cm, reflected, curve, green inside and tomentose cream outside. Stamens 4, epipetalous, basifixed, 0.4 cm length; filament brownish red, 0.2 cm length; anther purplish red, 0.1 cm length. Stigma capi-

tate, red; stylus 1-1.45 cm length, red-brown; ovary clavate, 0.5 cm by 0.1 cm, tomentose cream. Fruit berry, green, clavate, 0.8-1 cm by 0.2 cm, tomentose cream. Seeds 1, light green, covered with yellow sticky layer that lies between endocarpium and testa.

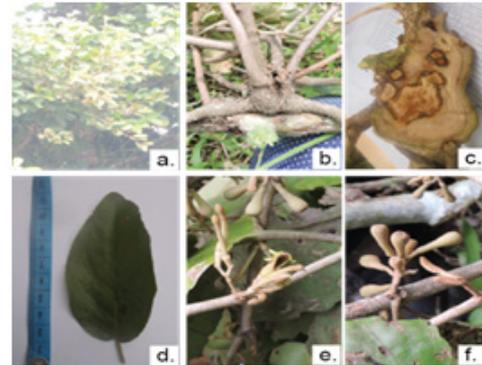


Figure 1. *S. artropurpurea*: a. habitus, b. haustoria, c. the cross section haustoria, d. leaf, e. flower, f. Fruit

Vernacular name: mengandi (Sasak Joben)

Habitat and ecology: secondary forests, altitude: 757-1000 masl., humidity: 79-91.5%, temperature: 23-27°C. Host plants: *Baccaurea racemosa*, *Citrus hystrix*, *Calliandra haemotecephala*, *Dalbergia latifolia*, *Euchesta horsfieldii*, *Ficus fistulosa*, *F. septica*, *Ficus* sp., *Glochidion* sp., *Laportea stimulan*, *Leocoyke capitellata*, *Macaranga tanarius*, *Mallotus moluccanus*, *Melastoma mabathrichum*, *Phyllanthus* sp., *Persea americana*, *Syzigium* sp., *Saurauria pendula*, *Pterospermum javanicum*, and *A. enneantha*. This mistletoe sticks to the trunk and branched of secondary, tertiary at a height of 3-15 m above the ground. This species can attach to other mistletoe such *A. enneantha*. Benefits: traditional utilization namely water decoction of the leaves can cure smallpox. Specimens examined: East Lombok, Joben Resort forest area is located in the southern part of Mount Rinjani: WDF: 1, 2, 16, 17, 18, 21 are stored in the herbarium of the Faculty of Mathematics and Science, Mataram University Lombok Indonesia (MUL).

2. *Macrosolen retusus* (Jack) Miq. Fl. Ind. Bat. 1, 1 (1856) 828. New record based on: Barlow (1997) (Figure 2).

Aerial stem-parasitic shrubs, thick, erect, 45-150 cm tall, glabrous. Haustoria were formed external gall and external runners epicortical. Adult stem cylindrical, fissure, lenticell, young stems flattened and widened at the end of node, levies, glabrous, green. Leaves opposite-decussate, subopposite, coriaceous, glabrous, dull,

polymorphic: obovate to elliptical, 4.5-9.8 cm length, 2-6.3 cm width; apex: rounded, obcordate, obtuse rarely acute; base: cuneate, oblique or obtuse; margin entire; venation pinnate, midrib and lateral veins distinct above, 7-8 veins per leaf; petiole 0.3-0.5 cm by 0.3 cm, glabrous. Inflorescences raceme axillary and at the nodes, 1-2 racemes per peduncle, peduncles 0.5-0.8 cm by 0.1 cm; 6-7 flowers per raceme; bracteole deltoid, glabrous, light green, imbricate, 3 at the tip of pedicle. Young flowers tubulate, 0.5-0.7 cm length, 0.2 cm width, perianth 6 merous, green, glabrous. Ovary botuliform, glabrous. Fruit berry, green, elipsoid, 0.7cm by 0.3 cm, glabrous. Seeds 1, light green, covered with white sticky layer that lies between endocarpium and testa.



Figure 2. *M. retusus*: a. habitus, b. haustoria, c. the cross section haustoria, d. leaf, e. flower, f. fruit.

Vernacular name: Mengandi (Sasak Joben)

Habitat and ecology: secondary forests and in the open area, altitude: 627-683 als., air-humidity: 71-97%, air temperature: 24-27^o C. Host plants: *D. latifolia*, *F. superba*, *F. fistulosa*, and *Mangifera indica*, attached to the trunk and the secondary branched, 3-15 m above the ground. Specimens examined: East Lombok, Joben Resort forest area is located in the southern part of Mount Rinjani: WDF: 10, 12, 13 and 14 (MUL).

3. *Amyema tristis* (Zoll.) Tiegh., Bull. Soc. Bot. France 41 (1894) 507; Danser, Bull. Jard. Bot. Butenzorg III, 11 (1931) 351; Backer & Bakh. f., Fl. Java 2 (1965)71; Barlow, Blumea 36 (1992) 371. New record based on: Barlow (1992 and 1997), Backer & Bakh. f. (1965) and Danser (1931) (Figure 3).

Aerial stem-parasitic shrubs, thick, erect, 30-45 cm tall, glabrous. Haustoria were formed internal gall and external runners epicortical.

Adult stem cylindrical, fissure, lenticel, brown, young stems cylindrical, levies, green; nodes swell forming gall, 0.5-1 cm by 0.3-1 cm.



Figure 3. *A. tristis*: a. habitus, b. haustoria, c. the cross section haustoria, d. stem *A. tristis* attack himself, e. nodus swell forming stem tumor, f. leaf

Leaves opposite, coriaceous, glabrous, polymorphic: ovate-elliptical, 4.6-7.1 cm length, 2-4 cm width; apex: acuminate, acute; base: truncate, oblique, obtuse; margin entire; venation pinnate, midrib and lateral veins visible, 5-6 veins per leaf; petiole sub-sessile, glabrous.

Vernacular name: mengandi (Sasak Joben)

Habitat and ecology: secondary forests, altitude 695 m als., humidity: 62%, temperature: 27^o C. Host plants: *F. septica* and *A. tristis*. Mistletoes attached to the trunk and secondary branched at 2 m above the ground. Specimens examined: East Lombok, Joben Resort forest area is located in the southern part of Mount Rinjani, WDF: 11 (MUL).

4. *Amyemaenneantha* Barlow, Blumea 36 (1992) 329. New record based on: Barlow (1992 and 1997) (Figure 4)

Aerial stem-parasitic shrubs, thick, erect, 50-150 cm tall, glabrous. Haustoria were formed internal gall and external runners epicortical. Adult stem cylindrical, fissure, lenticel, brown, 1-1.5 cm in diameter; internodes 3.5-10 by 0.3-1 cm; nodes swell forming knee gall, 0.5-1.2 by 0.6-1.5 cm; young stems cylindrical, levies, green. Leaves ternate; lamina coriaceous, glabrous, ovate to lanceolate: 5-14 cm length, 2.5-6.5 cm width; apex: acuminate or acute; base: attentuae; margin entire; venation pinnate, obscure, midrib

prominent on both side, 5-6 veins per leaf; petiole sessile- sub-sessile 0-0.2cm by 0.1 cm, glabrous. Inflorescences umbel simple, axillary and at the nodes, 6-9 umbels per peduncle, peduncles cylindrical, sessile-sub-sessile 0-0.1cm by 0.1 cm, green, glabrous; 6-8 flowers per umbel; pedicels 0.1 cm by 0.1 cm, glabrous. Bracteole triangular, 0.1 cm by 0.1 cm, glabrous, green, 1 at the end of pedicel. Flowers campanulate, 2-2.7cm length, 1 cm width, perianth 5 merous; calyx gamosepalous, lobes: 0.1 cm by 0.1 cm, glabrous, yellowish green; corolla, glabrous, red, glabrous, choriopetalous 2-2.7 cm by 1 cm, reflected, curve. Stamens 5, epipetalous, baxifixed, 1 cm length; filament yellow: 0.6 cm length; anther brown: 0.4 cm length. Stigma capitate, red; stylus 1.5-2 cm length, red; ovary botuliform, 0.3 cm by 0.2 cm, glabrous. Fruit berry, green, elliptical, 0.5-1 cm by 0.3 cm, glabrous. Seeds 1, brown, covered with sticky layer that lies between endocarpium and testa



Figure 4. *A. enneantha*: a. habitus, b. haustoria, c. the cross section haustoria, d. leaf, e. flower, f. Fruit

Vernacular name: Mengandi (Sasak Joben)

Habitat and ecology: secondary forests, altitude: 759-1500 mals., air humidity: 75-85%, air temperature: 24-27° C. Host plants: *F. septica*, *Glochidion* sp., *L. stimulan*, *M. mabathrichum*, *S. pendula*, *M. tanarius*. Mistletoes attached to trunk and secondary branched, at 3-5 m above the ground.

Benefits: utilization traditionally namely water decoction of the leaves can cure hemorrhoid. Specimens examined: East Lombok, Joben Resort forest area is located in the southern part of Mount Rinjani, WDF: 4, 5, 6, 19 and 20 (MUL).

5. *Amyema cuernosensis* (Elmer) Barlow, Blumea 36 (1992) 323, Pelsler (2015) (Figure 5).

Aerial stem-parasitic shrubs, thick, erect, 50-150 cm tall, glabrous. Haustoria were formed internal gall and external runners epicortical. Adult stem cylindrical, fissure, lenticell, brown, 1-12 cm in diameter; internodes 5-9.5 cm by 0.5-1 cm; nodes swell forming gall, 0.7-1 by 1-1.7 cm; young stems cylindrical, levies, green. Leaves opposite; lamina coriaceous, glabrous: ovate to elliptical, 7-17 cm length, 5-10 cm width; apex: acuminate-acute; base: attentuae-rounded; margin entire; shining above and dull bellow; venaton pinnate, midrib and lateral vein prominent visible on both side, 5-6 veins per leaf; petiole sessile-sub-sessile: 0-0.3 cm by 0.2 cm, green, glabrous.



Figure 5. *A. cuernosensis*: a. habitus, b. haustoria, c. the cross section haustoria, d. leaf, e. flower, f. fruit

Inflorescences umbel simple, axillary and at the node, 6-8 umbels per node, peduncles: 1-1.3 cm by 0.1 cm, glabrous; 6-8 flowers per umbel; pedicels: 0.2 cm by 0.1 cm, glabrous. Bracteole triangular, 0.1 by 0.1 cm, glabrous, green, 1 at the end of pedicel. Flowers campanulate, 3-3.5 cm length, 1-1.5 cm width, perianth 5 merous; calyx gamosepalous, glabrous, yellowish green, lobe, 0.1 by 0.1 cm; corolla red, choriopetalous: 2-2.7 cm by 1 cm, reflected, curve, puberulent. Stamens 5, epipetalous, baxifixed, 1 cm length; filament yellow, 0.6 cm length; anther brown, 0.4 cm length. Stigma capitate, yellow to red; stylus 1.5-2 cm length, red; ovary botuliform, 0.3 cm by 0.2 cm, glabrous. Fruit berry, green, elliptical, 0.5-1cm by 0.3 cm, glabrous. Seeds 1, brown, coated with white milky sticky layer that lies between endocarpium and testa.

Vernacular name: Mengandi (Sasak Joben)

Habitat and ecology: secondary forests altitude 679-747 masl., air humidity 93%, air temperature 24^o C. Host plants: *F. septica* and *L. Stimulan*. Mistletoes attached to trunk and secondary branched 5-10 m above the ground.

Specimens examined: East Lombok, Joben Resort forest area is located in the southern part of Mount Rinjani, WDF: 9 (MUL).

Mistletoe Diversity and Host Range

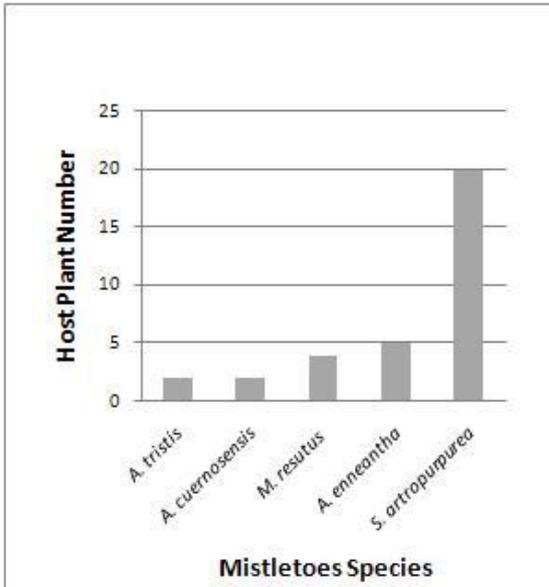


Figure 6. Graph host range of mistletoe in Joben Resort forest in the southern slope of Mount Rinjani Lombok.

A total of five mistletoes species belonging to three genera including Loranthaceae family (*Amyema*, *Macrosolen*, and *Scurrula*), were new recorded in the study area. These five mistletoes species were parasitizing 24 host plants belonging (Figure 6).

The fifth species of mistletoes distribution pattern can be shown (Figure 7) that each species has been found at specific altitude, on range of 627-1500 masl. Each species of mistletoe was found on different altitude.

For example: mistletoes were found at an altitude below 700 masl., such as: *A. tristis* (695 masl.), *A. cuernosensis* (679-747 masl.) and *M. retusus* (627-623 masl.), while the mistletoes were found above an altitude of 750 masl., e.g.: *A. enneantha* (759-1500 masl) and *S. artropurpurea* (757-1000 masl). The species of mistletoe that most impact host is *S. Artropurpurea*: attaching 192 individuals from 20 host species, *A. Enneantha*: attaching 71 individuals from six host species, *M. tris-*

tusus: attaching five individuals from the four host species, *A. Cuernosensis*: attaching two individuals from two species host, and *A. tristis* only attaching one individual (Figure 6 and 7). Mistletoes do not like the conditions thick canopy vegetation that the sun light doesn't up to the forest floor. This is due to mistletoes life as hemiparasite. They live under open areas, because they need sunlight to perform photosynthesis. The map of the distribution can be observed also the host of mistletoes: *A. enneantha* and *S. artropurpurea* have many of the populations most others species of mistletoes. However in Nigeria *Ibazia lebbeck* was the most vulnerable to mistletoe attack. (Dlama et al., 2016).

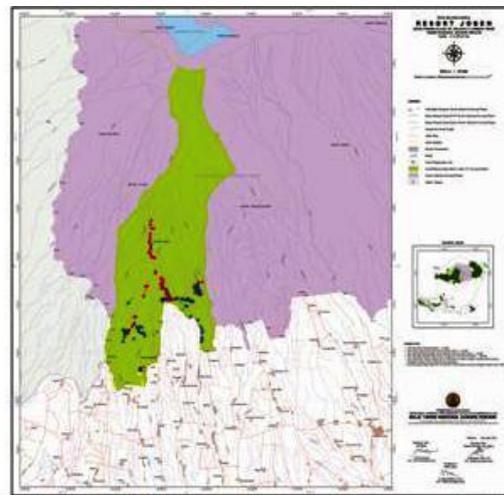


Figure 7. Map of distribution pattern of mistletoes in Joben Resort forest in the southern slope of Mount Rinjani Lombok: ● *A. cuernosensis*, ● *A. enneantha*, ● *A. tristis*, ● *M. retusus*, ● *S. Artropurpursa*

The important finding of the research are finding new species or new record of mistletoes, their hosts. The benefit of these new record or new species are providing new material of new medicinal for treating some diseases such as various cancers.

CONCLUSIONS

The research found five species of mistletoes were included in three genera i.e. *A. cuernosensis*, *A. enneantha*, *A. tristis*, *M. retusus* and *S. artropurpurea*. These five kinds of mistletoes were associated to 23 different species of plants from 19 genera and included in 13 families. The number of parasitized host every species of mistletoe is *A. cuernosensis* infect as much as two plants species; *A. enneantha* infect six plants species; *A. tris-*

tis infact one plant species; *M. retusus* infact four plants species; and *S. artropurpurea* infect most that 19 species of host plants. The most favourite host of these mistletoes was *Ficus septica* from Moraceae family. The most aggressive mistletoe was *Scurrula artropurpurea*.

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