BALI AND LOMBOK SPECIES OF *BEGONIA* (BEGONIACEAE)

BY:
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ABSTRACT

A taxonomic study of the genus *Begonia* Blume (Begoniaceae) in Bali and Lombok Islands were conducted based on morphological characters. Three previously known species (*Begonia coriaceae* Hassk., *B. longifolia* Blume and *B. tenuifolia* Dryander) five new species (*B. baliensis* Girmansyah *sp. nov*., *B. lempuyangensis* Girmansyah *sp. nov*., *B. lombokensis* Girmansyah *sp. nov.*, *B .multibractea* Girmansyah *sp. nov*, *B. pseudomuricata* Girmansyah *sp. nov*.,) are proposed. A key to species is included.

A phylogenetic analysis was undertaken using PAUP vers. 4. Ob4. Programs Swofford (2000) with Hillebrandia *sandwicencis* as out group. This analysis be resulted a parsimonious cladogram, which shows that the *Begonia divided* into three subclade and belong to four section (*Sphenanthera*, *Reichenheimia, Petermannia* and *Parvibegonia*).

ABSTRAK

Kajian taksonomi mengenai genus *Begonia* Blume (*Begoniaceae*) di Pulau Bali dan Lombok yang berdasarkan pada karakter morfologi telah dilakukan. Dari studi ini diketahui, terdapat delapan jenis. Tiga jenis sudah dikenal sebelumnya (*B .coriacea* Hassk., *B. longifolia* Blume, *B. tenuifolia* Dryander), diusulkan lima jenis baru (*B. baliensis* Girmansyah *sp. nov*., *B. lempuyangensis* Girmansyah *sp. nov.*, *Begonia lombokensis* Girmansyah *sp. nov.*, *B .multibractea* Girmansyah *sp. nov.*, *B. pseudomuricata* Girmansyah *sp. nov.*). Kunci identifikasi juga disediakan untuk pengenalan jenis-jenis *Begonia* di Pulau Bali dan Lombok.

Analisa hubungan kekerabatan menggunakan program PAUP vers. 4. Ob4. Programs Swofford (2000) dengan *Hillebrandia sandwicencis* sebagai *outgroup.* Dari analisa ini dihasilkan sebuah kladogram yang parsimoni yang menunjukan marga *Begonia* terbagi menjadi tiga kelompok dan termasuk ke dalam empat seksi yaitu *Sphenanthera, Rihenheimia, Petermannia* dan *Parvibegonia.*

LETTER OF STATEMENT

I express that thesis entitling:

BALI AND LOMBOK SPECIES OF *BEGONIA* (BEGONIACEAE)

are true represent result of my research and have never been published. All information and data that used have been expressed clearly and can be checked its truth.

Bogor, June 2008

Deden Girmansyah
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Thesis submitted
As partial fulfillment requirement for the Master Degree
In plant Taxonomy

THE GRADUATE SCHOOL
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2008

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CURRICULUM VITAE

The author was born in Garut, West Java on 6 February 1971, the first brothers from five children of the Mr. Pardjo and Mrs. Siti Rukibah.

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Begonia is the biggest genus in the family *Begonia*ceae. This genus is easily recognized by asymmetric leaf, unisexual flowers and winged fruits characters. That very asymmetric leaf is one of the special characteristic. *Begonia* is found wild throughout tropical and subtropical Asia, Africa and America. More than 1500 species have been named with many species waiting to be discovered.

This study was based on herbarium specimens of *Begonia* collected from Bali and Lombok Islands. The total number of 60 sheets specimens deposited in the Herbarium Bogoriense (BO) were examined. In addition some pictures of *Begonia* specimens from Leiden (L), Kew (K), Edinburgh (E) and Aurus (AAU) were consulted. The living plants in Bali Botanic Gardens and surrounded areas and some area of Lombok Island were also studied in-situ. Exploration was conducted at Bali and Lombok Islands as an addition of Bogor Herbarium collections. Exploration and specimen collection were based on the methods of Rugayah *et al* (2004).

All materials were studied and their morphological characters were examined with a 10 x 40 binocular microscope. The methods used were based on Leenhouts (1968), Rifai (1976), Vogel (1987) and Maxed (1992). For the morphological terminology the author follows Harris (1954), Lawrence (1955), Doorenbos (1998) and Kiew (2005) and a A phylogenetic analysis was conducted to clarify the relationships between species *Begonia* in Bali and Lombok using PAUP vers. 4. 0. (Swofford 2000).

Taxonomic study on Bali and Lombok Begonias were conducted. The recent study indicated that there were 8 species *Begonia* found in Bali and Lombok. Three species have been known previously (*Begonia coriacea, B. longifolia* and *B. tenuifolia*) and five new species were discovered (*Begonia baliensis, B. lempuyangensis, B. pseudomuricata, B. lombokensis* and *B. multibracteata*).

Some of the Bali and Lombok *Begonia*s are endemic. *Begonia lombokensis* and *Begonia multibractea* are only found in Lombok, while *Begonia baliensis, B. lempuyangensis* and *B. pseudomuricata* are only collected from Bali. Meanwhile the distribution of the *Begonia longifolia* extends from the Himalayas (India) to south China,Vietnam and through Thailand, Peninsular Malaysia, and Indonesia (Sumatra, Java, Bali and Lombok). Until now, there is no *B. longifolia* recorded from Borneo and eastern part of Indonesia like Sulawesi, Maluku and Papua. *Begonia coriacea* is a new record from Bali, it is one of the *Begonia* which grows on the lime stones. In Bali, this species was found only in Pura Lempuyang, Karang Asem Distric, east of Bali. One of the exiting Begonias we call as the spotted Begonia. The species name is *Begonia tenuifolia* found in Java, Bali, Lombok and Sumbawa. This species has wide variation in size of habit and leaf colour. It leaf colour is also variable ranging from bright green, dark brown green with spotted on upper side leaves. Fruits with unequal wings, the lager one have variation in size and tip of wing. The longest wings about 1 cm long with the tip rounded. While another wing with narrowly elongated and tip pointed. The extended small tuber is a specific character for this species.

Begonia is a very appreciated genus of ornamental plants, of economic relevancy, having species of flowers and foliage. These species can be used as foliage or flowers of varied coloration, usually commercialized in pots or to constitute gardens, very appreciated among the ornamentals. Some of Bali and Lombok Begonias have a nice morphological character. *Begonia tenuifolia* Dryander has a nice spot on the leaves. It is very nice plant if planted on the small pot and put as indoor plant. *Begonia coriacea* and *B. pseudomuricata* have flowers with pinkish rosy colour. The colour is very attractive and good for ornamental. The genus *Begonia* has flower with an acceptable taste. The rose petals contain relatively high levels of antioxidants. Meanwhile *B. baliensis, B. lempuyangensis* and *B. multibracteata* are Begonia with strong habit and big stem. All of them can be eaten as salad or cooked with fish. Especially for *B. lempuyangensis*, can be used as a palliative cough. Cane-like Begonia as *B. lombokensis* and *B. longifolia* are also can be eaten and used also for medical plant.

The phylogenetic analysis was result two parsimonious trees with 26 steps length, Consistency index (CI) of 0.72 and retention index (RI) of 0.81. To see relationship between Begonia in Bali and Lombok, hence the Javanese species also using in this analysis like *B. robusta*, *B. multangula*, *B. isoptera* and *B. muricata*.

There is a good relationship between Java, Bali and Lombok *Begonia* species. This analysis supported by Kalman (1955), there is no difference between the West and East element of plant and the Wallace line was meaningless for Bali and Lombok plants. However, it is too early to make a decision about the phylogenetic analysis of the Bali and Lombok *Begonia*, because of there is not enough species for this analysis especially from other location in Lesser Sunda Island. I have to improve by sampling more species. I hope this preliminary analysis can make ideas for further research.

INTRODUCTION

The first description of a plant what we now call *Begonia* was proposed by Francisco Hernandez, for a plant named 'Totocaxoxo coyollin' from Mexico in 1651. The second name applied was 'Tsjeria-nariampuli' for a plant from Malabar (India) described by Rheede in 1689. The name *Begonia* was proposed by Plumier in 1700 who described two species of *Begonia* from the Caribbean (Begonia *purpurea maxima* and *Begonia nivea maxima)*. In 1753 Linnaeus reduced both of the Plumier species into one species, named *Begonia obliqua.* In 1791, Dryander, the first monographer of the genus, described 21 species and mentioned 9 'species obscure'. In 1848, Hasskarl described *Begonia coriacea* as a new species. Klotzsch ('1854', 1855) published a result of a meticulous study of the large genus *Begonia* and splitted it into 37 genera. For example, he transferred some *Begonia* species to the genus *Mitscherlichia*. Miquel (1885) followed Klotzsch in splitting *Begonia* and made some new combinations for some *Begonia* species. Some species transferred to genus *Diploclinium, Mitcherlichia* and *Platycentrum.*

Since many scientists have worked on Begoniaceae, many taxonomic nomenclature changes have been made for the *Begonia*. In 1986 'The *Begonia*ceae' published by Smith *et al.*; part I, Smith and Wasshausen presented an illustrated; Part II, key to all known species, the great majority with pictures of the type specimen; the species list and relevant literature prepared by J. Golding and Karegeannes. In 1998, Doorenbos *et al* published a book entitled "The Sections of *Begonia*", that classified *Begonia* into 63 sections. Recently some new species of *Begonia* has been published by several scientists such as Tebbit (2005) who published *Begonia scottii* from Sumatra, Hughes (2006) published four new species of *Begonia* from Sulawesi named *B. chiasmogyna* M. Hughes, *B. macintyreana* M. Hughes, *B. mendumae* M. Hughes and *B. stevei* M. Hughes. Girmansyah (2005) reinstated *Begonia repanda* Blume.

Begonia is the biggest genus in the family *Begonia*ceae. This genus is easily recognized by asymmetric leaf, unisexual flowers and winged fruits characters. That very asymmetric leaf is one of the special characteristic.

Begonia is found wild throughout tropical and subtropical Asia, Africa and America. More than 1500 species have been named with many species waiting to be discovered (Kiew, 2005). Many species are used as ornamental plants. According to Burkill (1935) leaves of *Begonia* are also used as a flavoring for mixtures of fish and meat. Other species can also be used as a traditional medicine (Perry, 1980; Lewis, 1977). According to Watson & Dallwitz (2000) some *Begonia* contain secondary metabolites like proantosianin, mostly in the form of cyanidin, flavonols in the form of quercitrin and also saponins or sapogenins, and they also generally contain a lot of acid oxalates.

The aims of this study are to understand the species diversity of *Begonia* in Bali and Lombok islands and their distribution pattern, to provide an identification key to the species after being subjectively to critical revision, and to determine the relationships among the species of *Begonia* in Bali and Lombok using morphological character for cladistic analysis.

MATERIALS AND METHODS

Materials of study

This study was based on herbarium specimens of *Begonia* collected from Bali and Lombok Islands. The total number of 60 sheets specimens deposited in the Herbarium Bogoriense (BO) were examined. In addition some pictures of *Begonia* specimens from Leiden (L), Kew (K), Edinburgh (E) and Aurus (AAU) were consulted. The living plants in Bali Botanic Gardens and surrounded areas and some area of Lombok Island were also studied in-situ.

Methods of investigation

Exploration was conducted at Bali and Lombok Islands as an addition of Bogor Herbarium collections. Exploration and specimen collection were based on the methods of Rugayah *et al* (2004).

All materials were studied and their morphological characters were examined with a 10 x 40 binocular microscope. The methods used were based on Leenhouts (1968), Rifai (1976), Vogel (1987) and Maxed (1992). For the morphological terminology the author follows Harris (1954), Lawrence (1955), Doorenbos (1998) and Kiew (2005)

Phylogenetic analysis

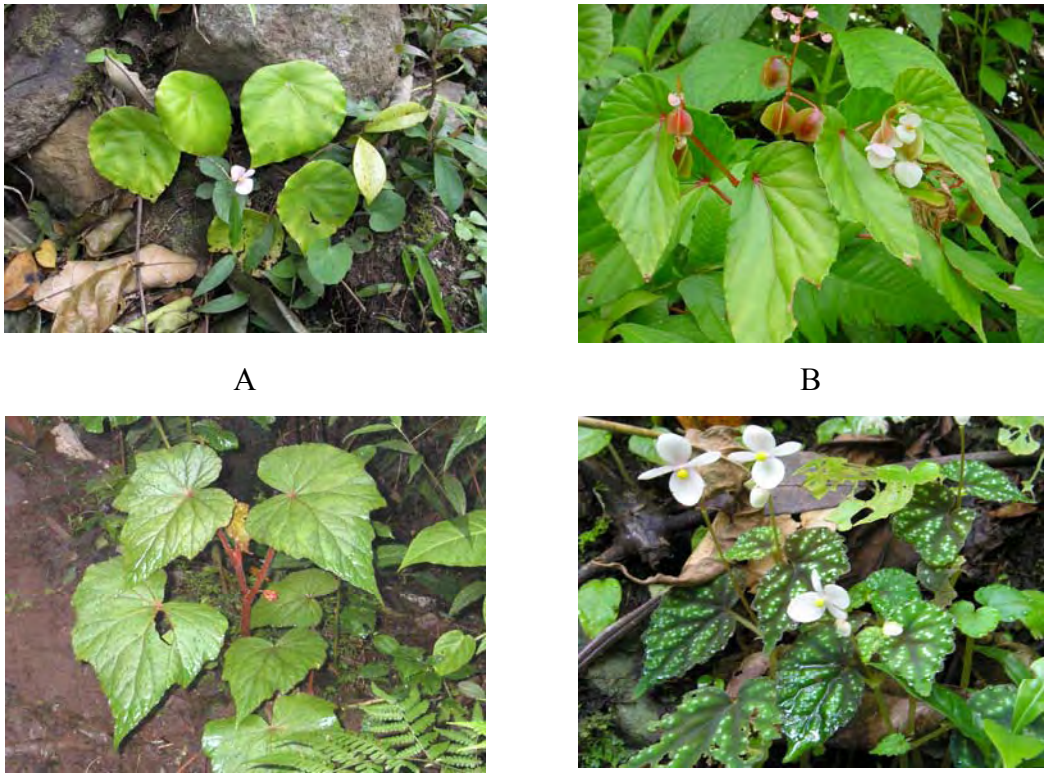
A phylogenetic analysis was conducted to clarify the relationships between species *Begonia* in Bali and Lombok using PAUP vers. 4. 0.
(Swofford 2000).

RESULTS AND DISCUSION

MORPHOLOGICAL CHARACTERS

Habit

In Bali and Lombok, most *Begonia*s are herbs and a few are creeping, rhizomatous, tuberous and cane-like shrubs with woody stems. *Begonia longifolia* Blume and *B. lombokensis* Girmansyah are cane-like *Begonia*s with erect stems and more than a half meter tall . *Begonia baliensis* Girmansyah, *B. lempuyangensis* Girmansyah , and *Begonia multibractea* Girmansyah are the shrub-like species. *Begonia coriacea* Hassk. and *B. pseudomuricata* Girmansyah are the creeping *Begonia*s which always found growing on the limestone. *B. tenuifolia* Dryand. is the tuberous.



A B C D

Fig 1. Habit form of Bali and Lombok Begonias. A. creeping (*B. coriacea*), B. cane-like (*B. lombokensis*), C. rhizomatous (*B. baliensis*) and D. tuberous (*B. tenuifolia*)

Leaves

Almost the Bali and Lombok *Begonia*s have oblique asymmetric leaves except *B. coriacea* which has peltate leaf. The leaf blade can be broad and cordate or heart-shaped like that of *Begonia baliensis, B. lempuyangensis*, *B. pseudomuricata* and *B. multibractea*; ovate to oblong such as the leaves of *B. longifolia*, *B. lombokensis*, *B. tenuifolia*; or peltate of *B. coriacea*. *Begonia tenuifolia* is the only species producing leaves of various shapes in its lifetime; it starts with rounded leaves and later produces narrowly ovate at maturity. The leaf margin of most species is very finely toothed but in few *Begonia*s like *B. lempuyangensis, B. multibracteata* and *B. baliensis,* the leaf margins are shallowly scalloped.

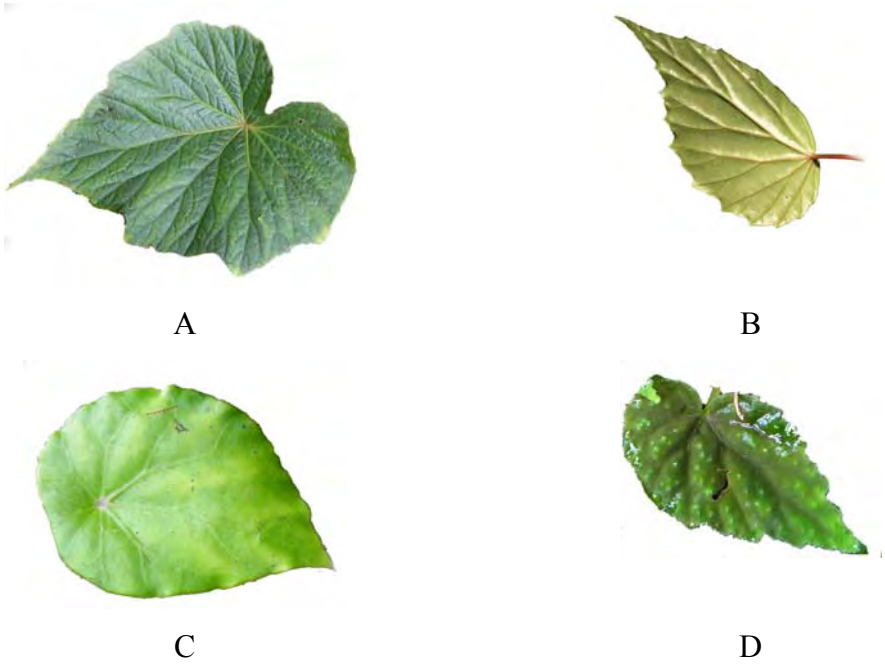


Fig 2.Leaf characters of Bali and Lombok *Begonia*s. A. Ovate with cordate base (leaf of *B. lempuyangensis*), B. Ovate with rounded and acute tip (leaf of *B. lombokensis*), C. ovate with peltate base (leaf of *B. coriacea*), D. ovate with special white dot (leaf of *B. tenuifolia*).

Inflorescence

There are two main groups of inflorescences of Begonias. The first group is terminal inflorescence where the inflorescence arise at the top of the stem. It can be found in *B. lombokensis* and *B. tenuifolia*. The second is axillary inflorescence in which the inflorescences arise from the leaf axils. It can be found in the rhizomatous species such as *B. baliensis, B. multibractea, B. lempuyangensis, B. longifolia, B. coriacea* and *B. pseudomuricata*. The arrangement of flowers in *Begonia* can be cymose and racemose. Cymose form can be found in *B. baliensis, B. lempuyangensis, B. multibracteata, B. pseudomuricata* and longifolia, whereas recemose form found in *B. tenuifolia* and *B. lombokensis.*

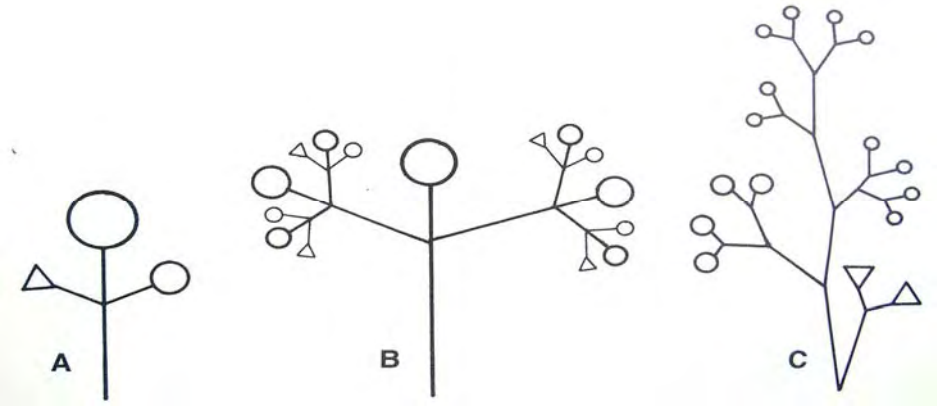


Fig. 3. Type of *Begonia* inflorescences, A,B. cymose, C. racemose.

Flowers

The flowers are small, measuring 1-2 cm across. The sepals are coloured and look like petals. Together these sepals and petals are called tepals. Most Bali and Lombok Begonia have white coloured tepals. Each flower has one sexual organ. It is unisexual but male and female flowers are found on the same plant, frequently on the same inflorescence so it is called monoceous.

Depending on the species, the male flowers may open first (protandrus) or the female flowers open first (protogynus). The male flowers have two larger rounded outer tepals, oriented top and bottom. The other two with narrower tepals that oriented left and right, as in the *B. baliensis, B. lempuyangensis, B. multibracteata, B.*

pseudomuricata, B. longifolia, B. tenuifolia and *B. coriacea*. The only *B. lombokensis* from Lombok has two male tepals. The female flowers are usually with five tepals of more or less the same shape but with the outer ones slightly larger than the inner, as in *B. baliensis, B. lempuyangensis* and *B. multibracteata*. In a few case, as in the *B. pseudomuricata* with three tepals, *B. longifolia* with six tepals and *B. lombokensis* with two tepals

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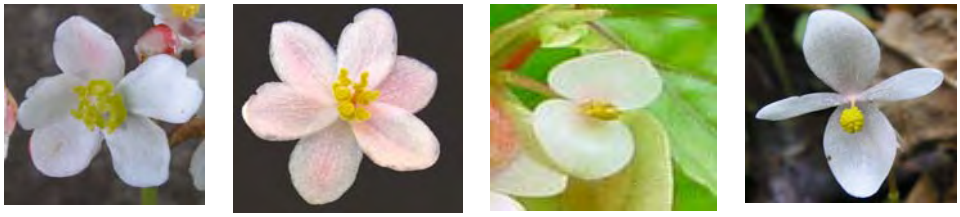

A B C D

Fig.4 Variation of female and male flowers in Bali and Lombok Begonias. A. female flower with five tepals (*B. baliensis*) , B. female flower with six tepals (*B. longifolia*), C. male flower with two tepals (*B. lombokensis*), D. male flower with four tepals (*B. tenuifolia*)

Fruits

There are two type of Begonia fruit are found in Bali and Lombok. The first, Fruit with tiny fiber wings are found in the cane-like Begonia, *B. lombokensis* which has fruit with three equal-sized wings and the tuberous Begonia, *B. tenuifolia* which hase fruit with one larger wing and two short wings are curved and the creeping *Begonia,* as in *B. coriacea* and *B. pseudomuricata* with three equal thiny wings. The third, fruit with thick and fibrous wings, like in rhizomatous Begonia, as in *B. baliensis, B. lempuyangensis, B. longifolia* and *B. multibracteata.*

A B C D

Fig.5. Fruity variation of Bali and Lombok *Begonia*s. A. berry-like with unequal wings (fruit of *B. lempuyangensis*), B. berry-like with equal wings (fruit of *B. baliensis*), C. capsule with unequal wings (fruit of *B. tenuifolia*), D. capsule with equal wings (fruit of *B. lombokensis*)

The shape of *Begonia* fruits are related to number of locule. The fruit with equal wings, like in *B. lombokensis, B. coriacea* and *B. pseudomuricata* and other species in rhizomatous group have tree locules each with one placenta. The other type of fruit with one larger wing has two locules with two placentas per locule, like in *B. tenuifolia.*

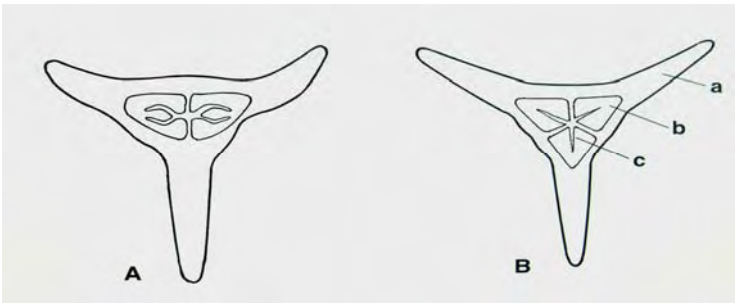

Fig. 6. The number of locules and placentas. A. fruit with two locules and two placentas per locule, B. fruit with three locules and one placentas perlocule (a. wing; b. locule; c. placenta)

Seeds and Seed dispersal

Begonia seeds are called dust seeds, because they are so tiny and very light. A single capsule produces hundreds of seeds. Like most *Begonia*, the Bali and Lombok *Begonia* seeds are brown, barrel-shaped and about 0.25-0.4 mm long. The base of the seed consists of the lid that narrows to the stalk that attaches the seed to the fruit. Above the lid is a ring of elongated cells called the collar cells, which are unique

feature of *Begonia* seeds. The rest of the seed is covered in polygonal cells. As the seed matures, the thin outer walls collapse and centre of the cell becomes concave while the cell walls stand out as ridges. This gives the seed its characteristic sculptured surface. When falling from the fruit, this uneven surface creates micro turbulence, which slow the rate of fall and potentially increases the distance seed from the mother plant. The rough surface also helps the seed to catch onto vertical rock surface. This probably explains why so many *Begonia*s grow on rock or on steep banks where leaf litter does not cover it. On the forest floor, tiny seedlings would be smothered by fallen leaves. However, the hundreds of seeds produced compensate for their high mortality.

Fruit types in *Begonia* are clearly related to the mode of seed dispersal. Seed in the fleshy green fruits of the berry *Begonia* such as *B. longifolia, B. multibractea* and *B. baliensis* are presumably eaten and dispersed by herbivores as the fruit does not split to release seeds. Several other Bali and Lombok *Begonia*s have dry winged capsules that split between the locules and wings and release the seed.

Begonia pseudomuricata and *B. coriacea* have three thin wings of equal size the fruit dangles down on a ling stalk. The slight movement whether by water drops hitting the plant or air movement, will shake the seeds out of the capsule. *Begonia lombokensis* has fruit with three equal-sized wings and a short stalk that holds the fruit below the leaves. The seeds will only be released if the plant is shaken by heavy rain or animals brushing past. The last called splash cup. The capsule has one large fibrous wing and two short curve wings. When ripe, the large, heavy wing hangs down like a keel of boat and the two short wings are upright and form a cup. The seed are dispersed by large water rain drops dripping from high up the canopy rain that hit the cup with great ballistic force bouncing the tiny seed out. It can be found in *B. tenuifolia.*

Dispersal of seed from the capsule appears to be local as the great majority of species occupy very narrow geographic range. In fact, geographical isolation has probably played an important role in the speciation of *Begonia*s. Exception for

Sphenanthera section or berry *Begonia*, (Tebbit, 2003) attributes is wide distribution from India to Java to its being animal dispersed.

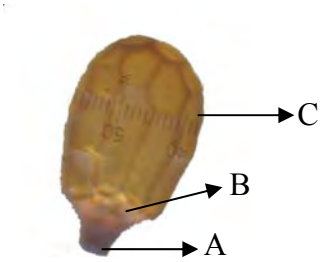

Fig.7. Seed of *Begonia* A. seed stalk scar. B. lid. C. collar cells

DISTRIBUTION

Begonias are found wild throughout tropical and subtropical Asia, Africa and America. To date more than 1500 species have been named with many more species waiting to be discovered. In Bali and Lombok, 8 native species are known. Some of the Bali and Lombok *Begonia*s are endemic. *Begonia lombokensis* and *Begonia multibractea* are only found in Lombok, while *Begonia baliensis, B. lempuyangensis* and *B. pseudomuricata* are only collected from Bali. Meanwhile the distribution of the *Begonia longifolia* extends from the Himalayas (India) to south China,Vietnam and through Thailand, Peninsular Malaysia, and Indonesia (Sumatra, Java, Bali and Lombok). Until now, there is no *B. longifolia* recorded from Borneo and eastern part of Indonesia like Sulawesi, Maluku and Papua. *Begonia coriacea* is a new record from Bali, it is one of the *Begonia* which grows on the lime stones. In Bali, this species was found only in Pura Lempuyang, Karang Asem Distric, east of Bali. One of the exiting Begonias we call as the spotted Begonia. The species name is *Begonia tenuifolia* found in Java, Bali, Lombok and Sumbawa. This species has wide variation in size of habit and leaf colour. It leaf colour is also variable ranging from bright green, dark brown green with spotted on upper side leaves. Fruits with unequal wings, the lager one have variation in size and tip of wing. The longest wings about 1 cm long with the tip rounded. While another wing with narrowly elongated and tip pointed. The extended small tuber is a specific character for this species.

Table 1. Distribution of Bali and Lombok *Begonia* and other relative site in Indonesia

Location / Species	SUM	JAV	BAL	LOM	KAL	SUL	MAL	PAP
B. baliensis	-	-	+	-	-	-	-	-
B. coriacea	-	+	+	-	-	-	-	-
B. lempuyangensis	-	-	+	-	-	-	-	-
B. lombokensis	-	-	-	+	-	-	-	-
B.longifolia	+	+	+	+	-	+	+	-
B.multibracteata	-	-	-	+	-	-	-	-
B.pseudomuricata	-	-	+	-	-	-	-	-
B.tenuifolia	-	+	+	+	-	-	-	-

Notes:

SUM = Sumatra KAL = Kalimantan
JAV = Java SUL = Sulawesi
BAL = Bali MAL = Maluku
LOM = Lombok PAP = Papua

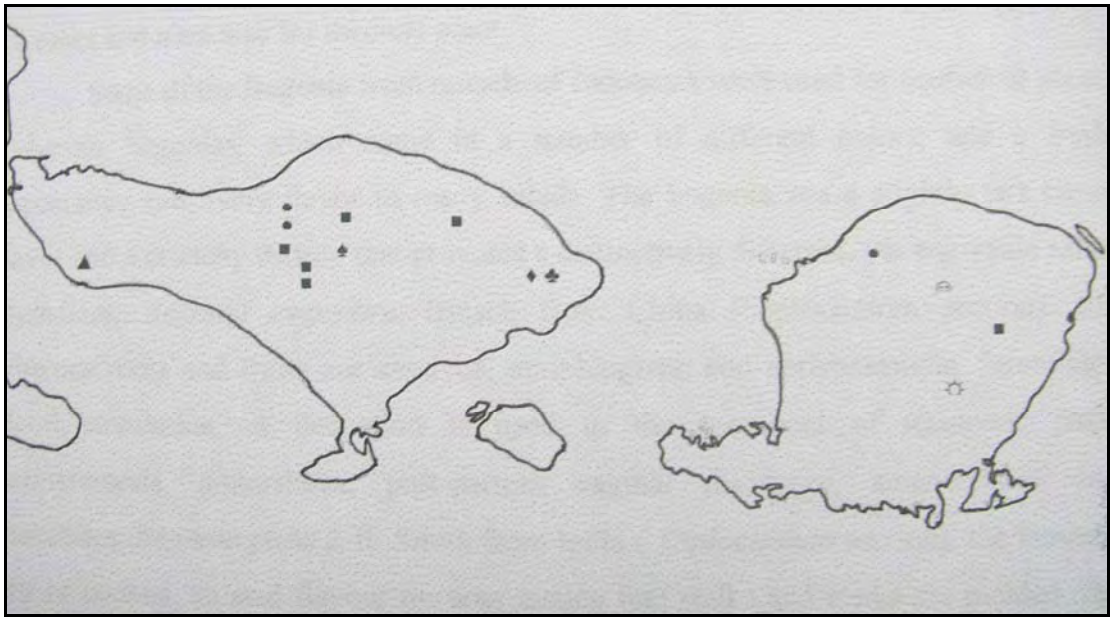

Fig.8. Distribution of Bali and Lombok *Begonias*, ▲ =*B. pseudomuricata,* ● = *B. tenuifolia,* ■ = *B. Longifolia,* ♠ = *B. Baliensis,* ♦ = *B. Coriacea,* ♣ = *B. lempuyangensis,* ☺ = *B. Multibracteata,* ☼ = *B. lombokensis*

POTENCIAL USES

Begonia is a very appreciated genus of ornamental plants, of economic relevancy, having species of flowers and foliage. These species can be used as foliage or flowers of varied coloration, usually commercialized in pots or to constitute gardens, very appreciated among the ornamentals. Some of Bali and Lombok Begonias have a nice morphological character. *Begonia tenuifolia* Dryander has a nice spot on the leaves. It is very nice plant if planted on the small pot and put as indoor plant. *Begonia coriacea* and *B. pseudomuricata* have flowers with pinkish rosy colour. The colour is very attractive and good for ornamental. The genus *Begonia* has flower with an acceptable taste. The rose petals contain relatively high levels of antioxidants. Meanwhile *B. baliensis, B. lempuyangensis* and *B. multibracteata* are Begonia with strong habit and big stem. All of them can be eaten as salad or cooked with fish. Especially for *B. lempuyangensis,* can be used as a palliative cough. Cane-like Begonia as *B. lombokensis* and *B. longifolia* are also can be eaten and used also for medical plant.

Some of the Begonia from outside of Indonesia were used for medicinal plant. Tuberous begonias, which come in a number of different colors, add a fresh appearance and lively flavor to many salads. The begonia has a slightly tart citrus flavor and a crunchy texture that provides a distinctively different, yet enjoyable salad ingredient. *Begonia evansiana* Irmsch from China (Diploclinium section), the tuberous roots and fruits are anodyne, antiphlogistic and antispasmodic. Stimulates blood circulation. A decoction is used in the treatment of traumatic pain, haematemesis, gonorrhoea, post-partum vaginal discharge, amenorrhoea and snakebites. *Begonia picta* J. E. Smith from India (*Diploclinium* section), the leaves - raw or cooked, an acid flavour the sour tasting leaf stalks and stems are pickled. the juice of the plant is drunk to relieve headaches. The crushed leaves are used as a poultice on sore nipples. The root juice is used as eyewash to treat conjunctivitis. It is also consumed in the treatment of peptic ulcers.

PHYLOGENETIC ANALYSIS

A phylogenetic analysis using PAUP vers. 4.0 was undertaken based on morphological characters, using *Hillebrandia sandwicencis* as the outgroup. The phylogenetic analysis used 16 morfological characters (Table. 1), which all of them are scored with primitive state base on the state of the outgroup. Data matrix of those characters which have been used for the analysis shown in table 2. The analysis result two parsimonious trees with 26 steps length, Consistency index (CI) of 0.72 and retention index (RI) of 0.81. To see relationship between Begonia in Bali and Lombok, hence the Javanese species also using in this analysis like *B. robusta, B. multangula, B. isoptera* and *B. muricata*.

Table 2. Characters and character states used in the phylogenetic analysis of the *Begonia*s with *Hillebrandia sandwicencis* as outgroup

No.	Characters	Character states
1.	Plant habit	0= rhizomatous; 1=with upright stem
2.	Leaves direction	0 = staright;1 =transverse
3.	Leaves shape	0 = Ovate; 1 = oblong; 2= peltate
4.	Venation type	0=palmate; 1= palmate-pinnate; 2=pinnate
5.	Inflorescence position	0= axillary; 1= terminal
6.	Inflorescence general arrangement	0=Cymose; 1=racemose
7.	Inflorescence protandrous or protogynous	0=Protandrous; 1=Protogynous
8.	Number of male tepals	0 =5; 1 = 4; 2=2;
9.	Filament fused	0=free; 1=partially fused
10.	Style persistent in fruit	0 =present; 1 = absent
11.	Stigma shape	0 =simple; 1 = Forked once
12.	Fruit shape	0=berry-like; 1=capsule
13.	Fruit dehiscent	0=irregularly dehiscence; 1= dehiscent near the wings
14.	Fruit position	0=more erect; 1=pendulous; 2=nodding
15.	Locule number	0=5; 1=3; 2=2
16.	ovary position	0=subinferior; 1=inferior

Tabel. 3. Matrix of morphological characters used for phylogenetic analysis of the genus *Begonia* in Bali and Lombok

Characters / OUT's	Characters															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H. sandwicensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. robusta	0	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1
B. multangula	0	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1
B.muricta	1	0	0	0	1	0	0	1	0	1	0	1	1	1	1	1
B.pseudomuricata	1	0	0	0	1	0	0	1	0	1	0	1	1	1	1	1
B. isopteran	0	1	1	2	0	1	1	2	1	1	0	1	1	1	1	1
B. baliensis	1	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1
B. coriacea	1	0	2	0	1	0	0	1	0	1	0	1	1	1	1	1
B. lempuyangensis	0	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1
B.lombokensis	0	1	1	2	0	1	1	2	1	0	0	1	1	1	1	1
B.longifolia	0	0	1	1	1	0	0	1	1	0	1	0	1	0	1	1
B.multibractea	0	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1
B. tenuifolia	0	1	0	1	0	1	0	1	0	1	1	1	0	2	2	1

The cladogram devided the taxa into Two groups which consists of group I: *Hillebrandia sandwicensis* as outgroup; group II consist of the *Begonia* genus was devided into two subgroup. The outgroup separated from the ingroup by having five male tepals (characters 13) and six locule (character 15) and subinferior ovary (character (16). The first subgroup consists of *Begonia robusta, B. multangula, B. baliensis, B. lempuyangensis, B. longifolia* and *B. multibracteata*. The first subgroup separated from the other subgroup by having (style persistent in fruit= character 10 and more erect fruit= character 14). This subgroup belongs to *Sphenanthera* section. The second subgroup consist of *B. muricata, B. pseudomuricata, B. coriacea, B. isoptera, B. lombokensis* and *B. tenuifolia.* The first group separated from the second

subgroup by having persistent style along fruiting (character) 10 and berry-like fruit in character 12. The second subgroup was devided into two other group: The first consist of *B. muricata, B. coriacea, B. pseudomuricata* belong to *Reichenheimia* section; the second devided into two group which *B. tenuifolia* is the sister group of *B. isoptera* and *B. lombokensis.* In the second group, the first group distinguish from the second group with character 4 (venation pinnate) and terminal inflorescence in character 5.

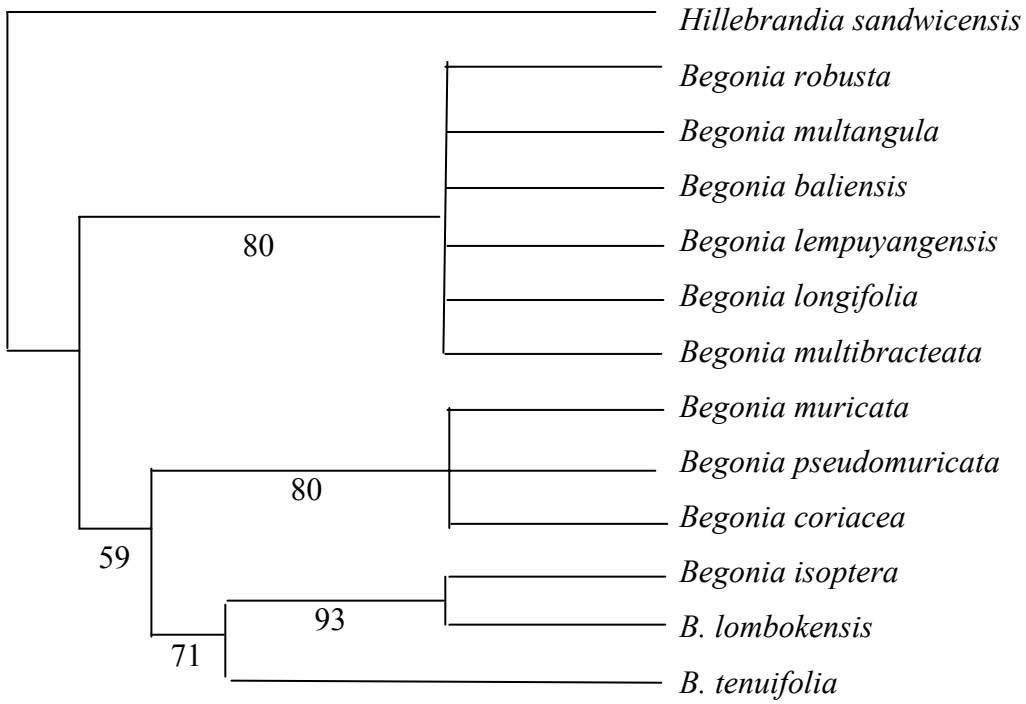

Fig.9. Caldogram of strict consensus of 2 most parsimonious trees with bootstraps support value

The tree also showing that *B. multangula, B. robusta, B. longifolia, B. baliensis, B. lempuyangensis* and *B. multibractea* closely related to one other formed a moderate support group with bootstrap support 80%. The other groups which consist of *B. muricata, B. coriacea* and *B. pseudomuricata* are also form a moderately supported group with bootstrap support 80%. Meanwhile the *B. isoptera* and *B. lombokensi* were supported with bootstrap support 93%.

There is a good relationship between Java, Bali and Lombok *Begonia* species. This analysis supported by Kalman (1955), there is no difference between the West and East element of plant and the Wallace line was meaningless for Bali and Lombok plants. However, it is too early to make a decision about the phylogenetic analysis of the Bali and Lombok *Begonia*, because of there is not enough species for this analysis especially from other location in Lesser Sunda Island. I have to improve by sampling more species. I hope this preliminary analysis can make ideas for further research.

TAXONOMY

GENERIC DESCRIPTION

Begonia L.

Linnaeus, Sp. Pl. 2: 1056 (1753); Linnaeus, Gen. Pl., ed. 5: 475 (1754); Linnaeus, Sp. Pl. ed 2:1497 (1763) **Type** : *B. obliqua* L. (Lectotype GOR)

Terrestrial or epiphytic, perennial or more rarely annual, monoecious or very rarely dioecious herbs, sometimes shrubs; Stems herbaceous, often succulent, or woody, frequently rhizomatous, or plants tuberous and either acaulescent or short-stemmed, rarely lianoid or climbing with adventitious roots. Leaves arranged spirally, stipulate, petiolate, asymmetric or exceptionally symmetric, sometimes peltate, entire to pinnatifid or rarely even bipinnatifid or palmately compound, pinnately or palmately veined, glabrous or pubescent, rarely with stellate hairs or scale-like trichomes; sometimes with bulbil in leaf axils. Inflorescence usually cymose, sometimes racemose or racemose with cymose branches, rarely 1 flowered, protandrous or protogynous; cymes dichasial and/or monochasial, sometimes with strongly reduce axes, bracts persistent or not, bracteoles often persistent. Flowers unisexual. Male flowers with 2 or (3-)4(-8) perianth segments, almost free to variously fused perianth segments; androecium with many stamens, actinomorphic or zygomorphic and sometimes the stamens arranged into several rows like an amphitheatre; filaments free or variously fused into a column; anthers with 2 thecae, opening lengthwise with slits, with pore-like slits or more rarely with terminal pores, connective frequently extended. Female flowers with 2-6(-9) free or partially fused, often unequal perianth segments which are rarely persistent in fruit; ovary inferior, with (1-)3-4(-7) often unequal wings or horns, more rarely wingless, broadly ovoid or ovoid to globbose or fusiform in shape, triangular, square or teretee in circumference, (1-)2-3(-6)-locules the locules sometimes incomplete; placention axillary or less often parietal or septal, occasionally changing from the bottom of the ovary towards the top, placental

branches 1-2(-4) per locule; styles (2-)3-4(-7), persistent or caduceous, often partly fused, once or more times forked towards the apex or more rarely simple, stigmatic tissue generally in a continuous band coiled around the arms, less often kidney-shaped or in an uncoiled band distributed all over the style. Fruit capsule, rarely berry-like and fleshy, usually loculicidal, more rarely indehiscent. Seed characterized by a ring of collar cells below the microphylar-hilar part which acts as an operculum during germination.

Key to Species

1. a. Perennial plant, without tuber, leaves many more than 5……..…….2
   b. Annual Plant with tuber, leaves 2-5…….*B. tenuifolia*
2. a. Stem creeping, internodes close, nodes not swollen.....3
   b. Stem erect, internodes distant, swollen at nodes.....4
3. a. Leaves peltate, female flowers four tepals, 2 female flowers…...*B. coriacea*
   b. Leaves ovate, female flowers three tepals, 8 female fls...*B. pseudomuricata*
4. a. Fruit with cartaceous wings, male flower with two tepals, female flower with two tepals…….……*B. lombokensis*
   b. Fruit with thick wings, male flowers with four tepals, female flower with five to six tepals……..…..…….5
5. a. Fruit wings equal-sized…….…….6
   b. Fruit wings unequally sized…..…..……..……..7
6. a. Lamina oblong, margin entire, glabrous, female flowers with six tepals……..……..…… *B. longifolia*
   b. Lamina ovate, margin scalloped , sparsely hairs, female flowers with five tepals…….…… *B. baliensis*
7. a. Inflorescence hairy, male and female flowers hairy outside of tepals, bract Many……..…..……..*B. multibractea*
   b. Inflorescence glabrous to glabrescent , male and female flowers glabrous to glabrescent, without bract...…… *B. lempuyangensis*

1. **Begonia baliensis** Girmansyah *sp. nov.* — Fig.9

Habitu *Begonia robusta* Blume simile, differt pedunculus brevis, floribus glabris, fructus parvis, glabris, alis aequalis non cornuatus, fructus similaris fructus *Begonia longifolia*Blume. **Type**: Bali Botanic Gardens area, Mt. Batu Karu, *Deden Girmansyah 801* (holotype BO)

Stem brownish green to reddish brown, erect and cane-like, succulent, rhizomatous, hairy, herbaceous, little branched, 15-50 cm tall, 8-15 mm diam; nodes brownish green to reddish brown, swollen; without a tuber. Stipules pale green, glabrous, narrowly triangular, 2-25 x 5-10 mm, margin entire, tip 2–3 mm long, setose, caducous. **Leaves** distant; petiole pale green to reddish brown, hairy, terete, 7.5 -30 cm long, 5-8 mm diam; lamina oblique, hairy above, thinly leathery in life, papery when dried, broadly ovate, asymmetric, 14–21 x 11-18 cm, broad side 6.5-11 cm wide, basal lobe rounded, 3.5–7.5 cm long, margin scalloped and minutely toothed, apex acuminate; venation palmate-pinnate, 2-3 at the base and 2 pairs along the midrib with 2–3 veins in basal lobe, branching one third of the way to the margin, grooved above, beneath prominent. **Inflorescences** axillary, few flowered, shorter than the leaves, peduncle green, glabrous, 2-8 cm long, male flowers 4, female flowers 7, protandrous; bract absent. **Male flowers** with a pale reddish green pedicel 1.3–2.5 cm long; tepals 4, white and red around the middle toward, glabrous, rotund, margin entire, tip rounded, outer two 13–15 x 11-12 mm, inner two similar but smaller, milky white, 11-14 x 8–9 mm; stamens many, stamen cluster globose, 5-6 mm across ; filament c. 1-2 mm long; anthers pale yellow, narrowly obovate, 1.5-2 mm long, apex emarginate, opening by slits. **Female flowers** with a pale green pedicel 4-5 mm long; ovary dark green with reddish brown at the larger wing, thick and fleshy, 7-9 x 5-8 mm, locules 3, placentas 2 per locule; tepals 5, milky white, outer two reddish white, broadly obovate, margin not toothed, tip rounded, 14–17 x 10-11 mm; styles 3, style and stigma greenish yellow, 4–5 mm long, stigma spiral. **Fruits** pendent on stiff fleshy pedicel, 4-5 mm long , berry green with ripe, fleshy,

10-15 x 10 mm, globose, elongated into a fleshy beak, glabrous, 3-lobed, with one larger wings, locules 3, not splitting, stigmas caducous. **Seeds** barrel-shaped, 0.25-0.3 mm long, collar cell almost as long as or ¾ the seed length.

Distribution: Bali
Habitat: Humid forest, along the trail at altitude 1300-1800 m.
Notes: This species is common in Bali. It grows from small colony to large population. This species similar with *B. robusta* Java, but different from several characters like shape and size of male and female flowers, fruits and leaves. It is also different from stem indumentum.
Specimen examined: Bali Botanic Gardens area, Mt. Batu Karu, 11-3-2007, *Deden Girmansyah 801* (BO); Mt. Batukaru complex, Bedugul. *KK & SS 93*(BO), Mt. Batukaru, North of Tabanan, 18-07-1964 (BO), Gunung Batukaru, *Meier . 385*(BO)

2. **Begonia coriacea** Hassk.— Fig.10

Begonia coriacea Hassk., Cat. Hort. Bogor. (1844) 192; Hassk., Pl. Jav. Rar., (1848) 239; Hassk., Hort, Bogor. Descr., (1858) 328. -- *B. hasskarlii* Zoll. & Mor., Syst. Verzeich., (1846) 31.-- *Mitscherlichia coriacea* (Hassk.) Klotz., Abh. Koningl. Akad. Wiss. Berlin (1855) 74. **Type:** Hort. Bog. 6075 (L.)

Begonia hernandiifolia Hook., Bot. Mag. 78 (1852) 4676. **Type:** Hooker, Plate 4676 (Smith et al. Cite this plate as the type).

Mitcherlichia junghuhniana Miq., Fl. Ned. Ind., 1.1 (1856) 696; - *Begonia junghuhniana* Miq., Pl. Jungh, 4 (1857) 418; **Type:** Junghuhn s. n. Java (lecto, here designated, L!, sheet no 898. 195-2).

Stem rhizomatous, up to 20 cm, subglobose, rooting at the nodes, succulent, unbranched, stout, without tuber, 10–18 cm long, 1–3 cm thick, nodes not swollen, internodes 5–15 mm long, 2.5–10 mm thick. Stipules broadly triangular, hairy on the middle, ending with a hair, spreading, 12-16 x 7-10 mm, margin not toothed, top pointed, ending in a hair, setose, persistent. **Leaves** tufted, up to 5-6 mm apart ; petioles teretee, glabrous, 10–21 cm long, c. 2-3 mm thick; lamina peltate, glabrous, oblique, drying papery, upper side plain dark green and glossy, pale green beneath, 16-24 x 13-23 cm, broad side 4.5-5.2 cm wide, base rounded c. 2,3 cm long, margin

not toothed, crenate, tip rounded; venation palmate-pinnate, 3 pairs with another 3 veins in peltate base, branching toward the margin, veins plane above, red beneath. **Inflorescences** axillary, glabrous, longer than the leaves, 10–16 cm long with a peduncle 9–15 cm long, branches 1–2 cm long, protandrous. Bract brownish green c. 3 x 2 mm, bracteoles pale green, margin hairy, c. 2 x 1 mm. **Male flowers** with pedicel, 5-6 mm long; tepals 4, margin entire, tip rounded, outer two orbicular, 10-13 x 9-13 mm, inner two narrowly obovate, 9-13 x 5-6 mm; stamens many, golden yellow, stamen cluster with a pedicel c. 1 mm long; filament c. 1 mm long; anther dull yellow, broadly obovate, 0.75–1 mm long, tip rounded, opening by slits. **Female flowers** with a pedicel c. 11 mm long; ovary, 3 locules, placenta 1 per locule; tepals 4, glabrous, outer two broadly obovate,11-13 x 10-11 mm, inner two narrowly obovate, 9-11 x 5-6 mm; style and stigma golden yellow 4 mm long, stigmas spiral. **Fruit** with a reddish green pedicel 10-11 mm long; capsule with 3 equal wings; locules 3. **Seed** barrel-shaped, c. 0.35-0.4 mm collar cell a quarter to the seed length.

Distribution : Java and Bali.
Habitat : Confined to karst limestone at 30-1000 m altitude, in shaded stony situations, steep gullies
Notes: This is the only peltate leaf *Begonia* in Bali and Lombok, it grows on limestone. Smith *et al.* (1986) did not locate Hasskarl's type; instead they cite Hooker's Plate. This species is a new record from Lombok and Bali.
Specimen examined: BALI. Lempuyang Temple, Abang subdistric. Distr. Karang Asem,13-3-2007, *Deden Girmansyah 802* (BO), Lempuyang. 24-4-2006, *DM 1267*(BO)

3. **Begonia lempuyangensis** Girmansyah *sp. nov.* — Fig.11

Begonia robusta Blume omino glabra, pedunculus breviore (petiolis pedunculis triplo longioribus), fructus alis non cornuatus differt.--Typus: Lempuyang Temple, Abang Subdistrict, Karang Asem Distr., 13-3-2007, *Deden Girmansyah 805* (holotype BO)

Stem brownish green to red, erect, unbranched, glabrous, succulent, arising from a basal rhizome, nodes swollen, up to 50 cm tall, 11–14 mm thick at base, nodes

red or reddish green, swollen; without a tuber, internodes short.7-12 cm. Stipules caducous. **Leaves** distant, alternate; green to brownish green, glabrous, 15 - 21 cm long; thick 6–11 mm; lamina very oblique, glabrous, thinly papery when dried, broadly ovate, asymmetric, 23.5–24 x 13-16 cm, broad side 8.5 - 14 cm wide, base deeply cordate, unequal, basal lobes not overlapping, basal lobe rounded 5-6.5 cm long, margin shallowly to deeply scalloped; venation palmate-pinnate, 2-3 pairs at the base and 2-3 pairs along the midrib with 2 pairs in the basal lobes, bifurcating at 1/3 from the base towards the margin, veins impressed above, beneath prominent, sparsely hairs. **Inflorescences** axillary, hairy with glandular hairs, erect, shorter than the leaves, peduncle 5-10 cm long, male flowers 12 and female flowers 8, protandrous. Bracts caducous. **Male flowers** with reddish to reddish white pedicel 2-2.5 cm long; tepals 4, rotund, margin entire, tip rounded, outer two reddish on the dorsal side, 14–17 x 12–14 mm, inner two smaller, white, 13–15 x 9-10 mm; stamens many cluster globose, filament 1–2 mm long, anther yellow, narrowly obovate, tip rounded, opening by slits, 2–3 mm long. **Female flowers** with reddish white pedicel, 9-1 mm long; ovary pale green with white spot, subglobose, 6-10 x 6-13 mm; wings 3, unequal, larger one with reddish on the margin, locules 3, placenta one per locule; tepals 5, white, broadly elliptic, margin entire, tip rounded, outer three, 9–17 x 7–11 mm, reddish around the middle, inner two glabrous, white, 9-13x6–9 mm, styles 3, styles and stigmas pale yellow and slightly greenish, style with stalk, 2 mm long, style greenish yellow, c. 3 mm long, stigma spiral, greenish yellow, c. 3 mm long. **Fruit** splash cup pendent on a fine pedicel, 9-11 mm long, berry, globose, c.11 x 17 mm, glabrouse, locules 3, wings 3, unequal, usually one longer than the other two. **Seeds** brown, broadly ellipsoid, 0.3-0.4 mm long, base truncate, rounded distally, collar cell a half to the seed length.

Distribution: Pura Lempuyang, Bali
Habitat: Humid shady situations, especially in umbrageous forest, on the forest floor at 1000 – 2000 m asl.
Notes: This species look like *B. robusta* in rhizomatous plant and leaves shape, but different in several characters. *Begonia robusta* has fruit with big one wing ,

peduncle more than a half of petiole length and habit be covered with long hairs while the *Begonia lempuyangensis* has fruit with similar or equal short wings, very short peduncle about a quarter of petiole length and habit without hair.
Specimen examined: G. Abang**,** 9-4 1936, v. Steenis 8059 (BO), Pure Lempuyang, Karang Asem, Bali. 13-3-2007, *Deden Girmansyah 805*(BO).

4. **Begonia lombokensis** Girmansyah *sp. Nov.* **—**Fig.12

Begonia isoptera Dryander foliis serratus, stipulis persistens angustae ovatae, flore femineo tepalis duo differt. **Typus:** Jeruk Manis water fall, Lombok, 18-3-2007, *Deden Girmansyah 812* (holotype BO)

Stem cane-like, glabrous, root at the base, stem green, up to 1m tall .internodes 2-8 cm, erect, much branched, succulent, woody at the base. Stipules green, glabrous, narrowly triangular, base truncate, margin entire, apex acuminate ending with a hair, caducous, c.17 mm. **Leaves** distant, held horizontally; Petiole glabrous, 1-8 cm, terete; lamina plain, thinly and soft when life, papery when dried, broadly ovate, strongly asymmetric, 8-15 x 3-7 cm, broad side 1,8-4 cm, basal lobe broadly rounded, 1-3.5 cm long, margin scalloped and toothed at the vein endings and minutely toothed between, apex elongate, venation palmate-pinnate, 2 veins in basal lobe, 4-6 pairs along the midrib, branching 2/3 of way to margin, plain above, prominent beneath. **Inflorescence**s axillary and terminal, pale green, shorter than the leaves, 2 pairs of female flowers at the base and many male flowers above, female flowers open first (protrandrus). **Male flowers** pedicels 1-2 cm, tepals 2, white or greenish white, broadly ovate, base truncate, margin entire, tip rounded, 8-15 x 5-10 mm; stamens many c. 24, cluster conical, filaments 1-2 mm, anther broadly obovate, c. 1 mm, tip notched, opening by slit, 1/3 part of anther. **Female flowers**, pedicel c. 13 mm long, ovary ellipsoid, glabrous, locule 3, placenta 2 per locule, 12-14 mm long; wings 3, equal, 6 mm wide; tepals 2, glabrous, pure white, basal truncate, margin entire, tip rounded, broadly ovate, 11-16 x 12-15 mm; style and stigmas pale yellow, 5-7 mm long, stigma spiral. **Fruits** with pedicels 1.2-2.8 cm long, capsule

broadly ovate, glabrous, locule 3, placentas 2 perlocule, splitting between the locules, 1.8-2.5 x 1.7-2.4 cm; wings 3, equal, entire angle, thinly fibrous, 7-9 mm wide. **Seed** barrel shape, c. 0.35 mm long, collar cells a half of seed length.

Distribution: Lombok (close to Jeruk Manis Water fall area)
Habitat: Open area and on the forest floor at 1000 – 2000 m asl.
Notes: This species has been found only on area near Jeruk Manis Waterfall. It is similar in habit, stem and leaves with *Begonia isoptera* from Java but different from number of female tepals and persistent stipule. The flowers of *Begonia isoptera* has five tepals, but in *B. lombokensis has* two tepals. This species is endemic in Lombok.
Examine specimen: Jeuk Manis Waterfall, 21-7-1003, *Tokuoka et al T.0030*(BO); Jeuk Manis Waterfall, 2-8-2003, *Tokuoka et al T0.334*(BO); Jeruk manis waterfall, along the trail to the Waterfall, Southern slope of Rinjani Mount, 18-3-2007, *Deden Girmansyah 812*(BO).

5. **Begonia longifolia** Blume —Fig.13

Begonia longifolia Bl., Catalogus, (1823) 102; Koord., Exkurs. Fl. Java. 2 (1912) 650; Back. & Bakh. *f.* Fl. Java. (1963) 313; Steenis, Mt. Fl. Java, Plate 5-7; Tebbitt, Brittonia. 55 (2003) 25 ; Kiew, Begonia of Penn. Malay. (2005) 107-111. *Diploclinium longifolium* (Blume) Miq., Fl. Ned. Ind. 1.1 (1856) 687. *Diploclinium longifolium var luxurians* Miq. ex Koord., in Exkurs. Fl. Java 2 (1912) 650. **Type:** Blume 740 Java, Salak (B †- holotype, L).

Begonia trisulcata (A.DC.) Warb., *in* Engler & Prantl, Nat. Pflanzenfam. 3.6A (1894) 142. **Type:** Zollinger 2850 Java, (G- holotype.).

Stem erect, cane-like, glossy, woody, unbranched, nodes swollen, stout, up to 150 cm tall, 2 cm thick at base; without a tuber. Stipules pale green, glabrous, narrowly triangular, 10–17 x 2–3 mm, margin entire, tip 2–3 mm long, setose, caducous. **Leaves** distant, 3-14 cm apart; petiole pale green, 2–15 cm long, grooved above; lamina oblique, green with short hairs on the upper surface, thinly leathery in life, papery when dried, oblong-lanceolate, asymmetric, 9–23 x 4–12 cm, broad side 2.5–7 cm wide, basal lobe rounded 1.5-6 cm long, margin minutely toothed, apex elongate; venation pinnate, 5-6 pairs of veins along the midrib and another 2–3 veins

in basal lobe, branching towards the margin, impressed above, beneath prominent. **Inflorescences** axillary, few flowered, once branched per axil, shorter than the leaves, 9–13 mm long, in fruit elongating to 14–17 mm, peduncle green, glabrous, 5–10 mm long, male flowers 3, female flowers 4, protandrous. Bract pair pale or whitish green, narrowly triangular, 6–12 x 2–4 mm, margin entire, tip narrowing and setose, persistent. **Male flowers** with a pale green pedicel 6–25 mm long; tepals 4, white, glabrous, rotund, margin entire, tip rounded, outer two c. 11 x 11 mm, inner two similar but smaller 9-11 x 7-10 mm; stamens many, stamen cluster globose, c. 5 mm across, pedicel 1.5 mm long; filament c. 1 mm long; anthers pale yellow, narrowly obovate, c. 2 mm long, apex emarginate, opening by slits. **Female flowers** with a pale green pedicel 5–7 mm long; ovary white becoming green, thick and fleshy, 3-angled on top shaped, 10–13 x 8–11 mm, locules 3, placentas 2 per locule; tepals (4-6), white, broadly oval, margin not toothed, tip rounded, 11–12 x 8–9 mm; styles 3, style and stigma greenish yellow, 4–5 mm long, stigma spiral. **Fruit** pendent on stiff fleshy pedicel, 7–10 mm long , berry green with ripe, fleshy, 14–20 x 12–17 mm, globose, elongated into a fleshy beak, c. 4–6 mm long, glabrous, 3-lobed, without wings, locules 2–3, not splitting, stigma persisted. **Seed** barrel-shaped, 0.25-0.3 mm long, collar cell almost as long as or ¾ the seed length.

Distribution: Northeastern India, Bhutan, Southern China (Yunan to Fujian, including Hainan), Taiwan, Myanmar, northern Thailand, northern and central Vietnam, Peninsular Malaysia, Sumatra, Java, Bali and Sulawesi.
Habitat : Umbrageous forest, humid forest, river side 1000 -2000 m asl altitude.
Notes: Very widespread distributions. *B. longifolia* is distinct from other species in Sect. Sphenanthera in being completely glabrous. The others are densely hairy.
Specimen examined: BALI. Bedugul Forest Region, Mt. Batukau Complexs, 23-6-1958, *Kostermans cs* 92 (BO); Batu Karu, 23-1-1935, *de Voogd* 2142 (BO); Mt. Abang, 7-4-1936, *v. Steenis* 7925 (BO); Bratan Kaldera, 11-4-1936, *v. Steenis* 8075 (BO); Bedugul. Bali Botanic Gardens Area, 11-3-2007, *Deden Girmansyah 802* (BO)

6. **Begonia multibracteata** Girmansyah s*p. nov.* — Fig. 14

Begonia robusta Blume bracteis et bracteolis persistens, petiolis pedunculis triplo longioribus, fructus glabra vel glabrescens sine aliis cornuatus differt. **Type:** Mt. Rinjani , Between shelter 1 and schelter 2, trail to the summit from Senaru, 16-3-2007, *Deden Girmansyah 811* (holotype BO).

Stem rhizomatous, rooting at base, green to reddish green, hairy, succulent, unbranched, up to 1 m tall. Stipule broadly triangular, base truncate, margin entire, apex acuminate, persistent, ending with a hair, 25-18 x 8-16 mm. Petiole green to reddish green, hairy, 7-13 cm long. **Leaves** distant, hairy on both of leaves surface; lamina broadly ovate, strongly asymmetric, basal unequal hearth shape, not overlapping , margin deep scalloped, toothed, each tooth tipped by a hair, apex acuminate 11-17.5 x 8.5-15 cm, broad side 4.5–8.5 cm, basal lobed 10-15 cm long; venation palmate pinnate, 2 pairs at the base, 4-5 pairs along the midrib, 2-3 in basal lobed, branching towards the margin, vein impress above, prominent beneath. **Inflorescence** axyllary, cymose, erect, hairy, peduncle shorter than petiole c. 6.5 cm long, with two main branches. Bract glabrous, violet, broadly ovate, persistent. **Male flowers** white, pedicels 2,5-4 cm, tepals 4, margin entire, tip rounded, outer tepals hairy on outside, broadly ovate, 16-17 x 12-13 mm; inner two oval, 14-15 x 7-9 mm; stamen yellow, c. 87, cluster globose 6 mm in across, filament pale yellow, 1-2 mm long, anther yellow, oblong to narrowly obovate, tip notched, opening by slits, 2-2.5 mm long. **Female flowers** white, pedicels 5-7 mm long, ovary thick and fleshy, 3 angled, 1-13 x 14-20 mm, locule 3, placentas 2 perlocule. Tepals 5, outer one broadly ovate with scattered hairs outside, 18 x 12 mm, inner one smaller, narrowly ovate, glabrous, 18 x 8 mm; style 3, yellowish green, stigmas spiral, Y shaped, 7-8 mm long. **Fruit** berry, pedicels hairy, 9-15 mm long, globbose, scattered hairs, 3 lobed, each lobed with a fleshy ridge, without wings, locule 3, not splitting, 1.2-1.8 x 1.5-2.3 cm; stigmas persisting. **Seed** barrel-shaped, c. 0.4 mm long, collar cells halp the seed length.

Distribution: Mt Rinjani, between Senaru village and the summit.
Habitat: Primary Forest floor 1000–2000 m asl.
Notes: This species was found on the forest floor along the trail between shelter I and shelter II in Rinjani Mt. They scattered on a small colony, associated with Gesneriads and Urticaceae. This species similar with *B. robusta* in habit with rhizomatous stem, but different from indumentum and colour of leaf , colour and indumentum of flowers while fruits without the larger wing. This species has also special characters on the inflorescences. The male flowers cover by more than one big persistent bract
Specimens examine: Rinjani Mt, around position 2, 26-7-2003, *Tokuoka et al* T-0150(BO), Rinjani MT, Between shelter 1 and schelter 2, trail to the summit from Senaru, 16-3-2007, *Deden Girmansyah 811*(BO).

7. **Begonia pseudomuricata** Girmansyah *sp. nov.*—Fig. 15

Begonia pseudomuricata Girmansyah, habitu *Begonia muricata* Blume simile, differt caule glabra vel glabrescens, floribus glabris et fructus rubellus. **Type:**Tegal Cangkring, Negara, Bali, 15-3-2007, *Deden Girmansyah 810* (holotype BO).

Stem rhizomatous, rooting at the nodes, pale green to reddish, unbranched, hairy, succulent, slender , up to 5 cm tall, 5-9 mm thick, without a tuber. Stipules bright rosy red, broadly triangular, 9-10 x 10-11 mm, margin entire, hairy along the middle toward, tip ending with a long hair 0.9-1 cm. **Leaves** tufted; petiole pale green to bright rosy red, hairless, 5-20 cm long, 2-4 mm diam, rounded in cross section; lamina oblique, pale green above and beneath, thinly succulent in life, thin and papery when dried, slightly glossy above, ovate, strongly asymmetric, 5.5-10 x 5-9 cm, broad side 3-5.5 cm wide, base heart shaped, unequal, basal lobe 2-3 cm long, margin undulating, very minutely toothed, apex acute; veins palmate-pinnate, 2-3 pairs of vein at the base and 2-3 pairs along with midrib with 1-2 in the basal lobe, branching a halfway to margin, veins slightly impressed above, slightly prominent beneath, without hairs. **Inflorescences** axillary, peduncle brownish pale green, without hairs, erect, longer than the leaves, 10- 25 cm with two main branches 1-2 cm long, male flowers 8, female flowers 10, protandrous. Bract pair elliptic, c. 3x1 mm, persistent. **Male flowers** with a yellowish green pedicel, 10-15 mm long, tepals 4,

pale pink outside, almost white inside, glabrous, margin entire, apex rounded, outer two ovate, 12-15 x 11-12 mm, inner two narrowly oval 15- 19 x 7 mm, stamen many, cluster globose, filament 0.5-1 mm long, anther yellow, narrowly obovate, tip rounded, opening by slits, 0.7-1 mm long. **Female flowers** with reddish white pedicel, 7-9 mm long; ovary reddish white , subglobose, 7-8 x 4-5 mm; wings 3, equal, locules 3, placenta one per locule; tepals 3, pink, broadly elliptic, margin entire, tip rounded, two, 10-11 x 9-10 mm, smallest one, pinkish white, 9-10 x 3-4 mm, styles 3, styles and stigmas pale yellow and slightly greenish, style without stalk, style greenish yellow, c 2 mm long, stigma spiral, greenish yellow, c 2 mm long. **Fruit** dangling on a fine pedicel, 5-10 mm long, capsule, c. 1.1 x 1.7 cm, locules 3, wings 3, equal. **Seeds** barrel-shaped, broadly ellipsoid, 0.2-0.3 mm long, collar cell a quarter to the seed length.

Distribution: Tegal Cangkring area, Western of Bali.
Habitat: Humid shady situations, especially in umbrageous forest, on the flat forest floor 1000 – 2000 m asl.
Notes: this species allied to *Begonia muricata,* mainly in creeping habit but different from indumentum of stem, plain upper surface of leaves, glabrous tepals and colour of fruits and flowers.
Specimen examined: Negara, Tegal Cangkring, *Deden Girmansyah 810* (BO); G. Pala, *R. Maier Sarip 278*(BO).

8. **Begonia tenuifolia** Dryander —Fig. 16

Begonia tenuifolia Dryander, Trans. Linn. Soc., 1 (1791) 162 Pl. 14: Fig. 4.; Koord., Exkurs. Fl. Java. 2 (1912) 651; Back. & Bakh. *f.* Fl. Jav. 1 (1963) 308. -- *Platycentrum tenuifolium* (Dryander) Miq., Fl. Ned. Ind., 1.1 (1856) 693. **Type**: Trans. Linn. Soc., 1 (1791) 162 Pl. 14: Fig. 4.

B. rupicola Miq., Pl. Jungh., 4 (1855) 418; *Platycentrum rupicolum* Miq., Fl. Ned. Ind. 1(1) (1856) 693. **Type:** *Junghuhn s. n.* G. Gambing (Lectotype L, here designated, sheet no 898.195-178).

Stem pale green, succulent, weak, erect, 2- 25 cm tall, diameter 1-4 mm, little branched, densely or sparsely hairy, hairs short, white; tuber small, c. 5 mm. Stipules caducous. **Leaves** oblique, distant, 1–3 or more on each stem or branchlet; petioles translucent, pale green or whitish green, densely to sparsely hairy, 0.5-10 cm long, flat or grooved above; lamina dull plain green above and whitish or pale reddish beneath; thin and soft in life, thinly papery when dried, broadly ovate, asymmetric, 1.5–8.5 x 1.2-6 cm, broad side 0.7-3.2 cm, base unequally cordate, basal lobes not overlapping, 0.3-2.3 cm long, margin minutely toothed with sparse hairs, sometimes undulate, apex blunt or rounded; venation palmate-pinnate, 4–5 pairs of veins, with another 2 in the basal lobe, plane or slightly impressed above, beneath slightly prominent, whitish green or reddish. **Inflorescences** terminal, reddish white, glabrous, longer than the leaves, peduncle 5-20 cm long, branched, 1–4 cm long, protandrous. **Male flowers** pure white to pinkish white pedicel 10-11 mm long; tepals 4, margin entire, tip rounded, outer two rounded, 7-10 x 6-7 mm, inner two narrowly oval, 7-10 x 2.5-.3 mm; stamens many, cluster globose, stalk 2 mm long; filament 0.5–0.75 mm long; anther yellow, obovate, *c.* 1 mm long, tip rounded, opening by slits. **Female flowers** white to pinkish white, pedicel 5-12 mm long, ovary pinkish white, wings 3, unequal, locules 2, placentas 2 per locule; tepals 5, white, ovate, margin entire, tip rounded, outer one bigger , 9-12 x 3-4 mm, innermost one smaller, 6-11 x 2-3 mm; styles 2, Y-shaped, styles and stigmas yellow, style 3-4 mm long, stigma spiral, 1.5-2 mm long. **Fruit** pinkish white or pale green, capsule 5-6 mm wings 3, unequal, larger wing 3-7 mm wide, smaller two 2-3 mm wide. **Seeds** brown, ellipsoid to oblong, 0.3-3.5 mm long, collar cell a half or 3/4 the seed length.

Distribution: Java, Sumatra, Bali, Nusa Tenggara
Habitat and Ecology: Shade situations, steep gullies stony and sometimes growing on karst limestone at 50-900 m asl.
Notes: The spotted *Begonia* shows a great range in habit and leaves size. It begins to flowers when the plant 2 cm tall, and has two leaves, each leaf 1.5 cm long. In damp and sheltered conditions it grows up to 25 cm tall with up to four well leaves, the largest up to 8.5 cm. The spotted *Begonia* is apparently a short-lived species, the

vegetative state dying down in the dry season, and then sprouting again from tuber in the beginning rainy season. It also regenerates from seed; small plants and seedling can always be found.

Specimen examined: BALI. Boomloop Dajan, 8-2-1935, *de Voogd* 2104 (BO); Baturuen, Troenjan, 23-3-1936, *de Voogd* 2773 (BO); Gitgit Waterfall, Buleleng Distr. 5-4-1936, *C.G.G.J. van Steenis* 7764 (BO); Danau Batur, Trunyan, 0-3-1992, *J.J. Afriastini* BI-214A (BO); Gitgit Waterfall, Buleleng Distr. 13 -3 -1007, *Deden Girmansyah 804* (BO).

LOMBOK. Inland from the Noorthern East, near Gangga fall in Valley, Genggeang village, *Tobe 1130* (BO).

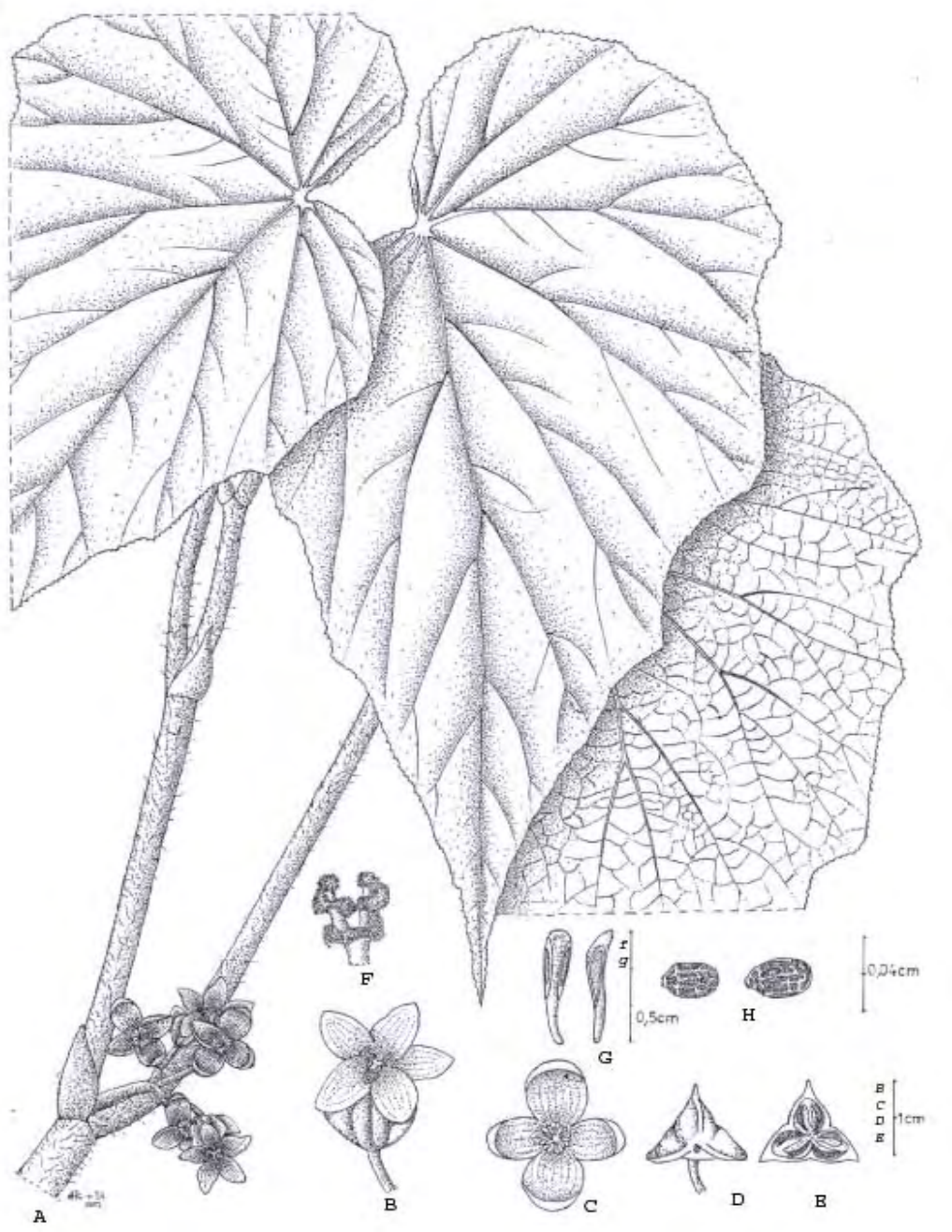

Fig.10. *Begonia baliensis* Girmansyah, A. habit, B. female flower, C. male flower, D. Fruit E. fruit in cross section, F. style, G. stamens, H. seeds

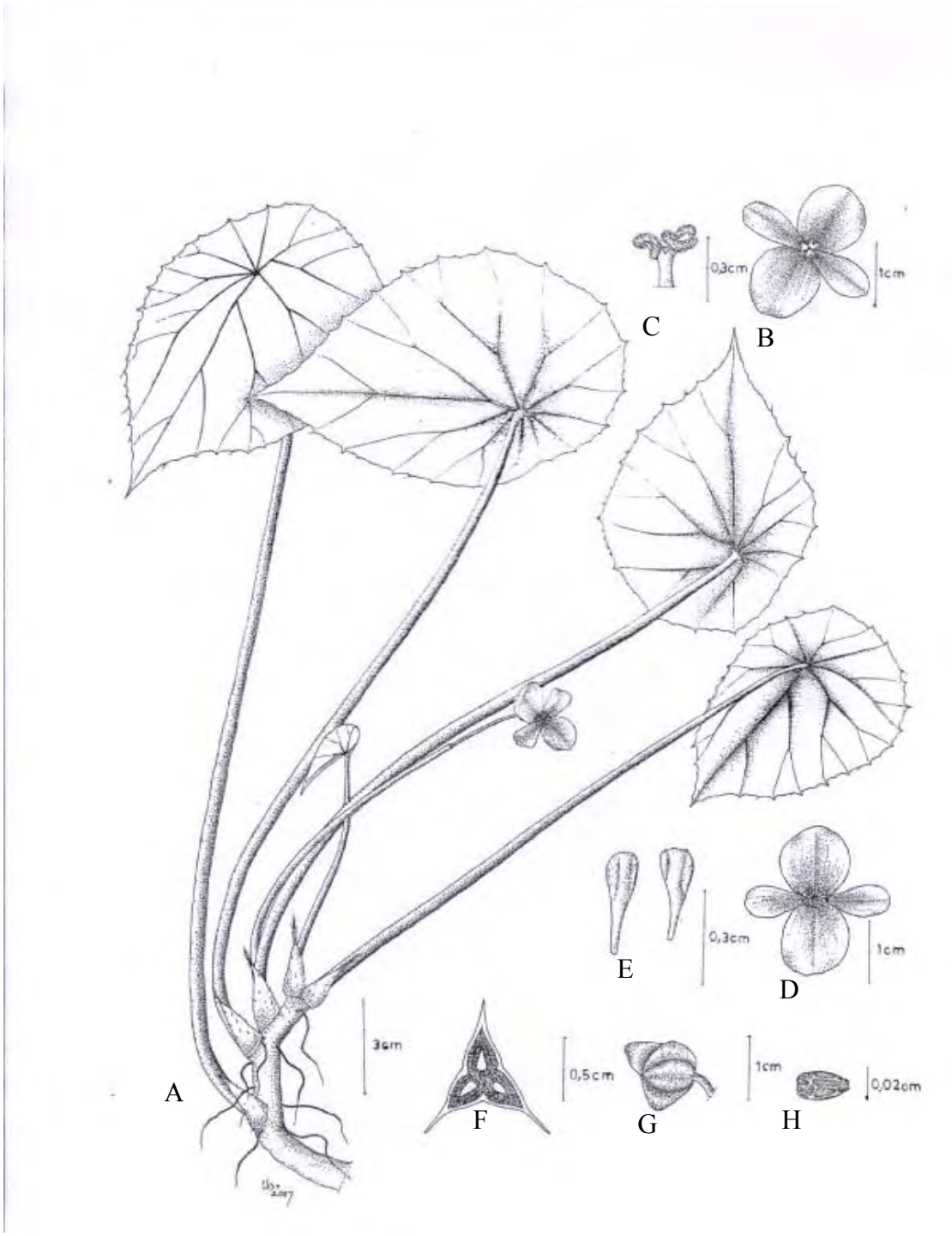

Fig.11. *Begonia coriacea* Hassk., A. habit, B. female flower, C. style, D. male flower, E. stamens, F. fruit in cross section, G. fruit, H. seed

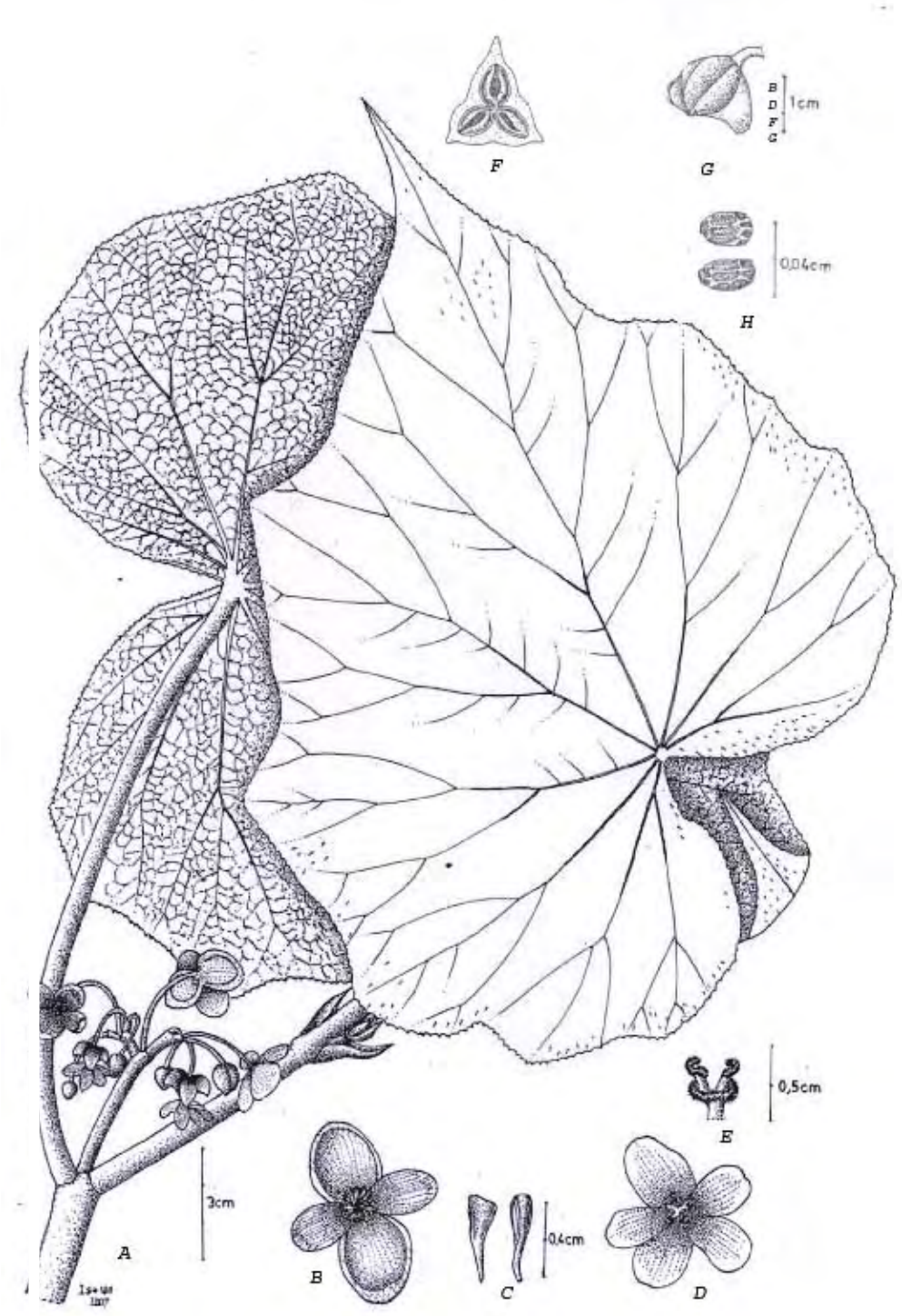

Fig.12. *Begonia lempuyangensis* Girmansyah, A. habit, B. male flower, C. stamens, D. female flower, E. style, F. fruit in cross section, H. fruit, I. seeds.

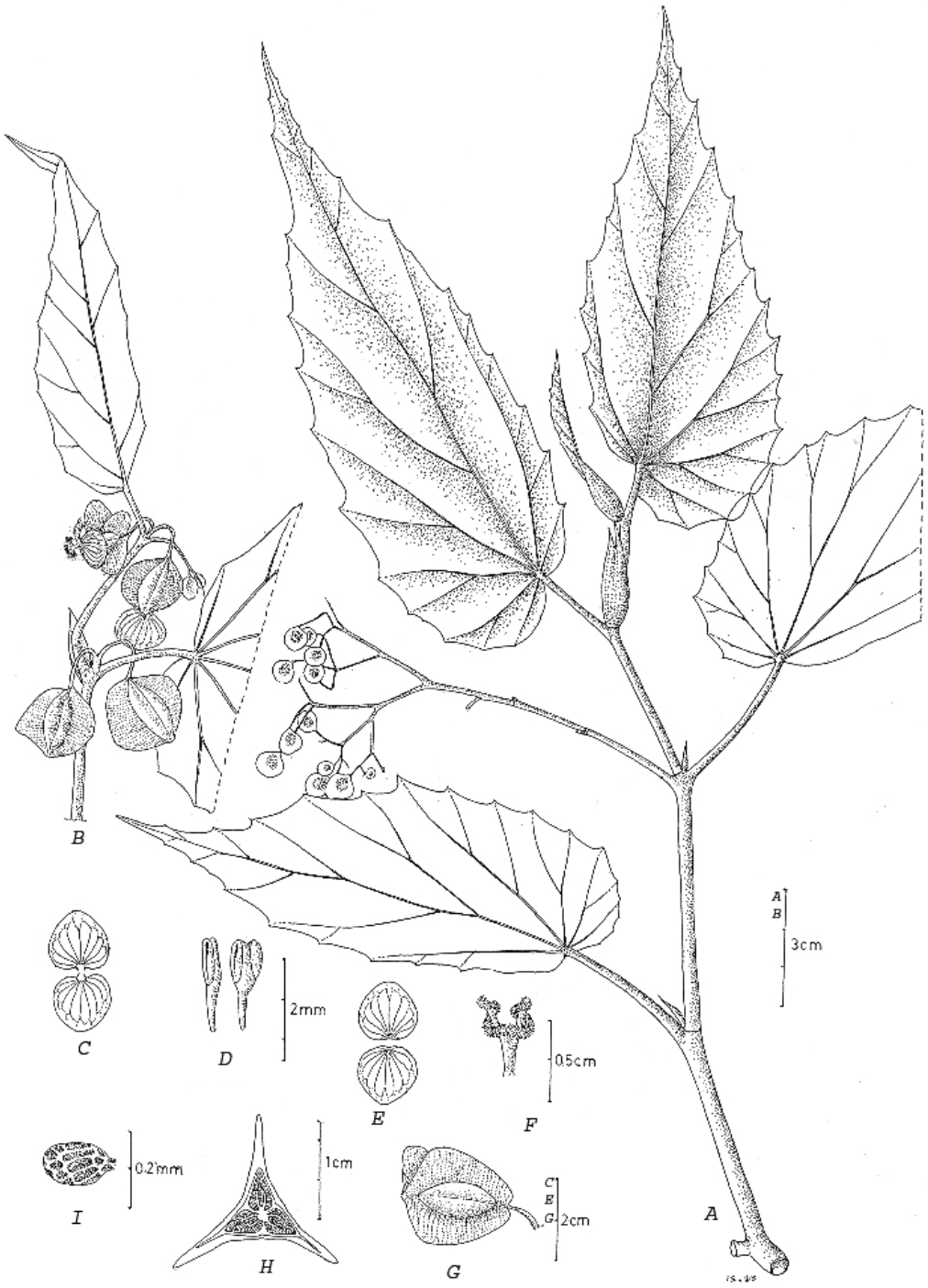

Fig.13. *Begonia lombokensis* Girmansyah, A. habit, B. male inflorescence, C.male flower, D.stamens, E. female flower, F. style, G. fruit, H. fruit in cross section, I. seed

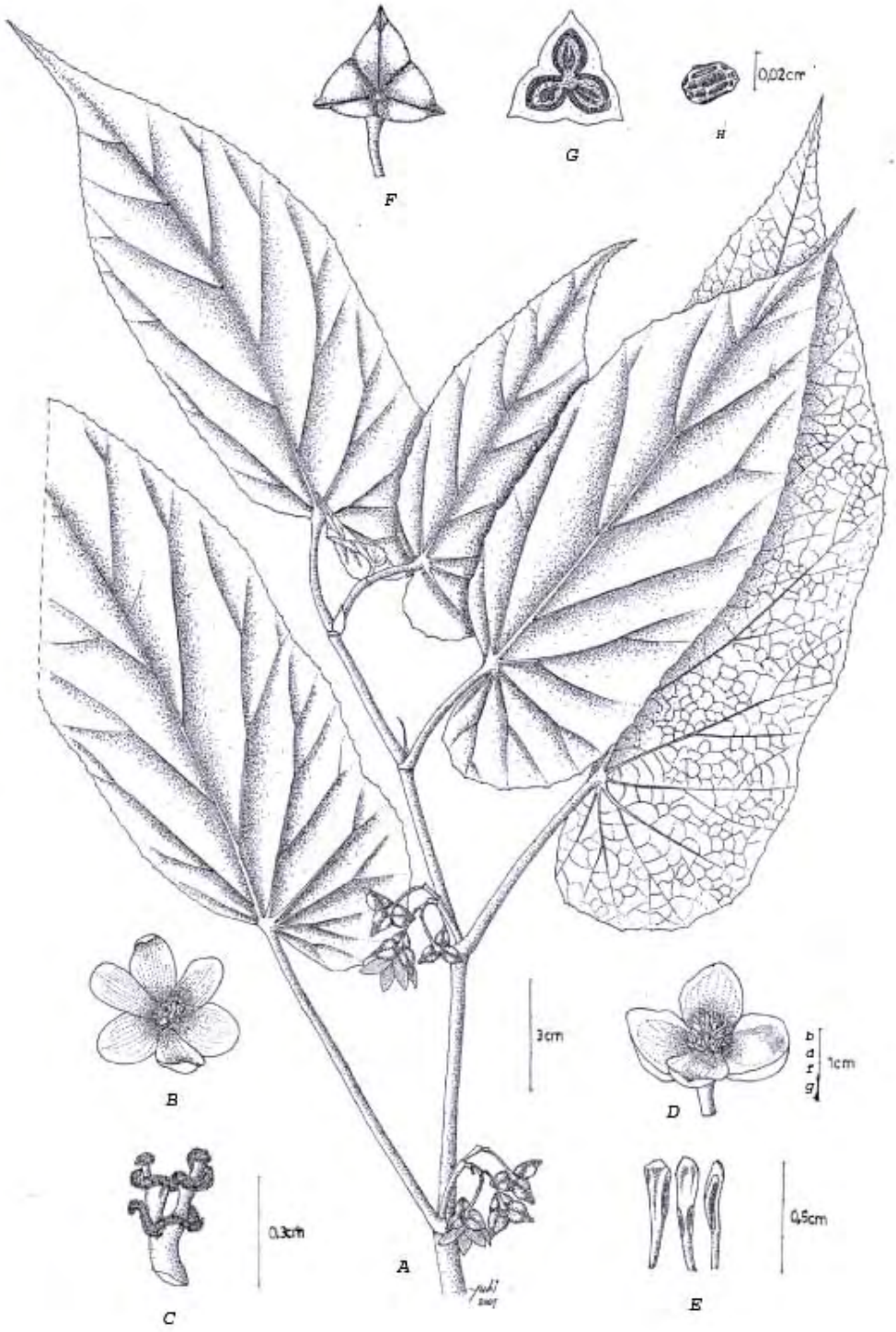

Fig.14. *Begonia longifolia* Blume, A. habit, B. female flower, C. style, D. male flower, E. stamens, F. fruit, g. fruit in ceoss section, h. seed

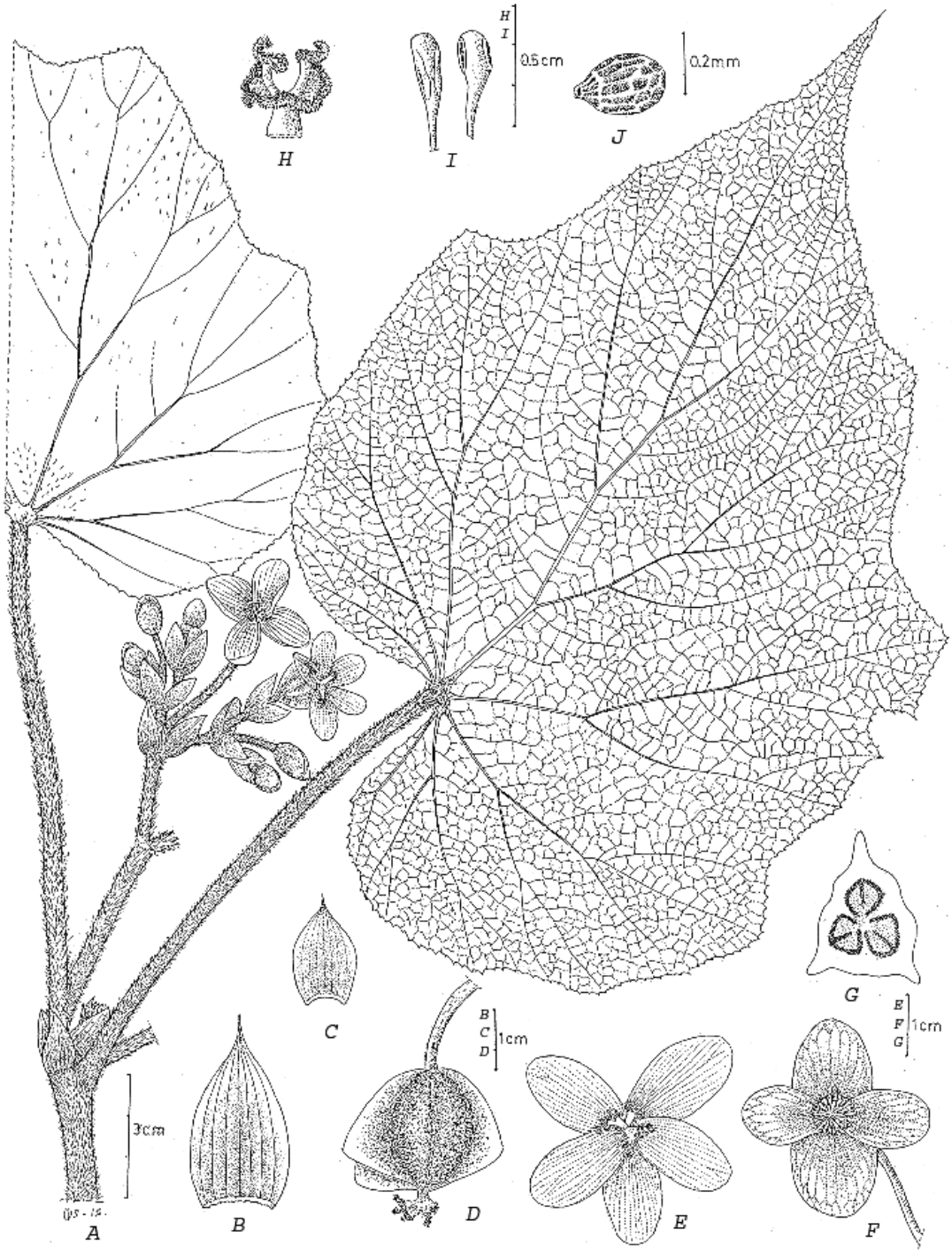

Fig.15. *Begonia multibracteata* Girmansyah, A. habit, B. bract, C.bracteole, D. fruit, E.female flower, F. male flower, G.fruit in cros section, H. stamens , I. style, J. seed

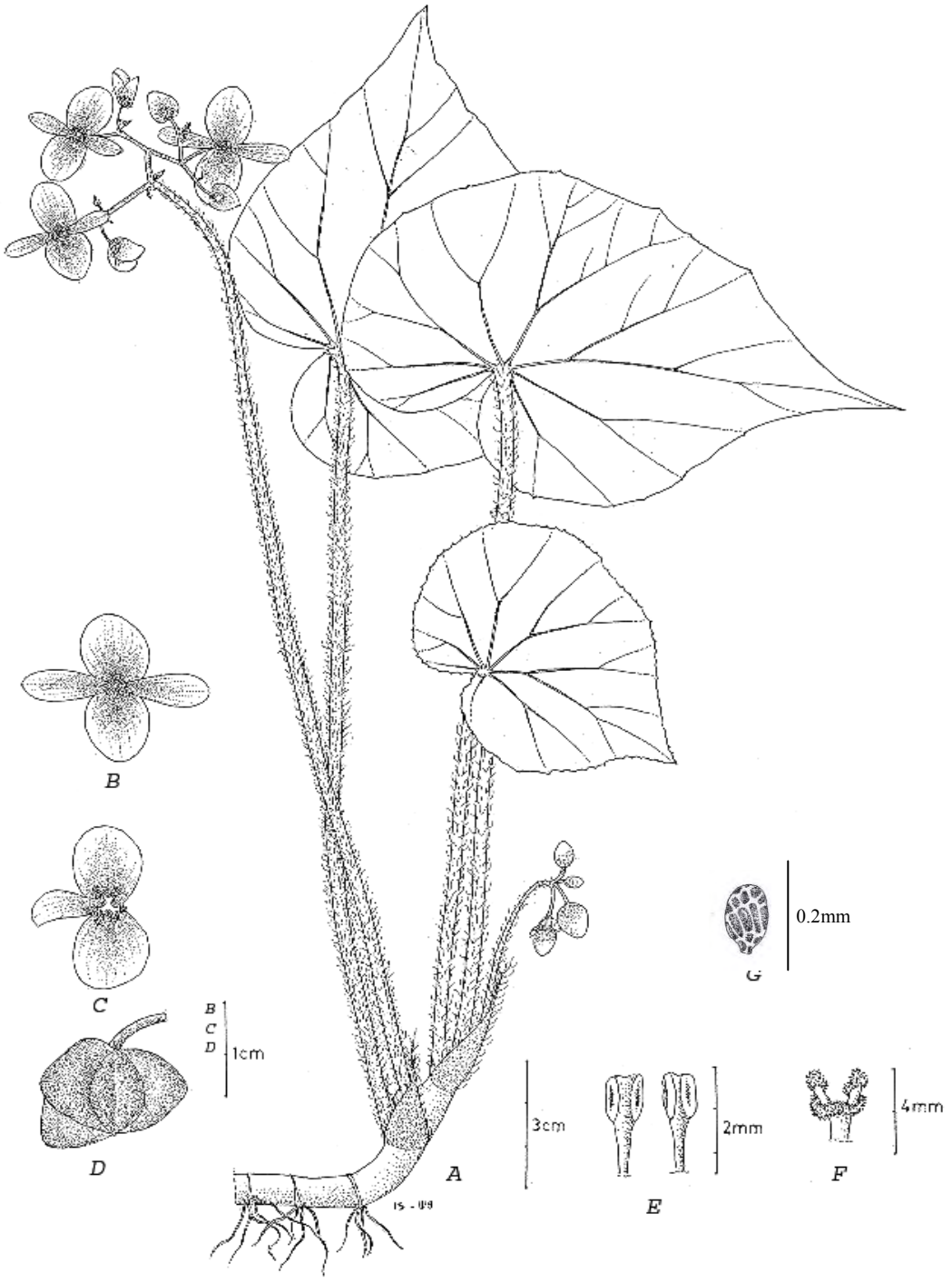

Fig.16. *Begonia pseudomuricata* Girmansyah, A. habit, B. male flower, C. female flower, D. fruit, E. stamens, F. style, G. seed

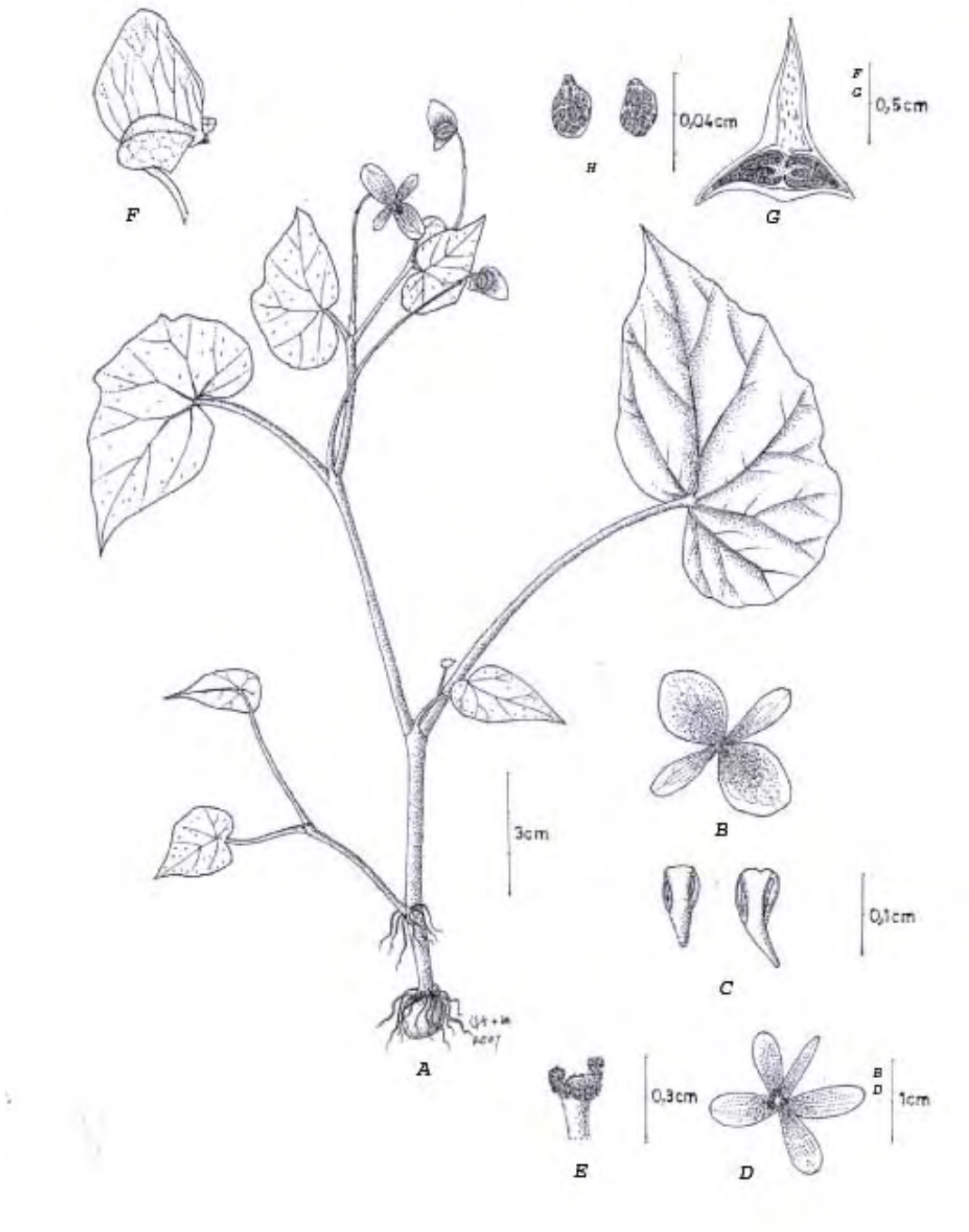

Fig.17. *Begonia tenuifolia* Dryand., A. habit, B. male flower, C. stamens, D. female flower, E. style, F. fruit, G. fruit in cross section, H. seeds

CONCLUSION

The recent study indicate that there were 8 species *Begonia* in Bali and Lombok. Three species have been known previously as *B. coriacea* Hassk., *B. longifolia* Blume and *B. tenuifolia* Dryand. Five species were proposed as new: *B. baliensis* Girmansyah, *B. lempuyangensis* Girmansyah, *B. lombokensis* Girmansyah, *B. multibracteata* Girmansyah, and *B. pseudomuricata* Girmansyah. An analysis of *Begonia* distribution in Bali and Lombok, indicate that *B. longifolia, B. coriacea* and *B. tenuifolia* are widely distributed. Whereas *B. baliensis, B. lempuyangensis, B. pseudomuricta B. lombokensis* and *B. multibracteata* have limited distribution. *Begonia* in Bali is higher than Lombok with 6 species while Lombok have 4 species. A phylogenetic analysis is undertaken using PAUP vers. 4. Ob4. Programs Swofford (2000) with *Hillebrandia sandwicencis,* as out group . This analysis be resulted a parsimonious cladogram, which shows that the *Begonia* is divided into two subgroups and four sections belong to *Sphenanthera, Reichenheimia, Petrmannia* and *Parvibegonia*. Bali and Lombok Begonias are potential for vegetables, ornamental and medicinal plant.

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