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New Record *Marsdenia tenacissima* (Asclepiadoideae, Apocynaceae) In Gunung Ijo Baturagung Yogyakarta

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Abstract

Marsdenia tenacissima population were found among wild bushes at S 07 º 47' 03.4"; E 110º 30' 48.0" about 415 meter above sea level in Gunung Ijo Baturagung Yogyakarta. Identification was based on literature and herbarium specimen. The research was conduct using exploration methods, morphoanatomical observation, and specimen collection. *Marsdenia tenacissima* in Jawa was not reported in Flora of Java. *Marsdenia tenacissima* habitus was liana. The specific character for its identification was pollinia's structure. This paper presented other important character namely leaf, stem, flower, pollinia, and fruit of *Marsdenia tenacissima* in Gunung Ijo Baturagung Yogyakarta. Accurate description and examination of any plant species were needed for its conservation and awareness of public to local biodiversity.

Keywords: *Marsdenia tenacissima*, Asclepiadoideae, Gunung Ijo, Baturagung

Introduction

Exploration, observation and assessment of wild plants on Gunung Ijo Baturagung Yogyakarta had found lianas (Widodo, 415 m, December 31, 2012) among wild bushes (S 07 ° 47 '03.4 "; E 110º 30 '48.0 ". After collection and re-observation on flower, analysis of fruit development and the thoroughly identification, it is conclude that the plant species are *Marsdenia tenacissima*.

Marsdenia belongs to tribe Marsdenieae of the subfamily Asclepiadoideae (Takhtajan, 2009). According to Backer and Bakhuizen (1965) there are three Marsdenia in Java, namely *Marsdenia tinctoria* or *Pergularia parviflora*, *Marsdenia crocea*, and *Marsdenia stenocentra* or *Marsdenia villosa*. Hooker (1885) states that the distribution of *Marsdenia tenacissima* include western Himalayas, North Oudh, Bengal, mountains of Rajmahal, Chittagong, Ceylon, also found in the East. It is estimated that this species in Java was identified as *Pergularia crocea*, Zipp.

From the description and Bakhuizen Backer (1965) above, the existence of *Marsdenia tenacissima* in Java was unexplained but Hooker (1885: 36) insist that this species is very similar to *Pergularia crocea*, Zipp.

The Plant List (2010) states that Marsdenia genus comprises about 447 species. The members of this taxon in this genus often unclear and led to misidentification. Observation on the species characters are necessary to provide valid identification of Marsdenia species.

Borlage (1895) listed the Marsdenia species in Indonesia, namely: (1) *Marsdenia tinctoria* R. Br or *M. parviflora* Decaisne or *Pergularia parviflora* Bl. or *Pergularia tinctoria* Spreng. The plants are distributed all over Java, Kalimantan, Sulawesi, and Sumatra, (2) *Marsdenia tenacissima* Wight. Et Arn. or *Asclepias tenacissima* Roxb. or *Gymnema tenacissima* Spreng. Its distribution includes Timor and Sulawesi, (3) *Marsdenia villosa* Bl. or *Pergularia villosa* Bl, which has distribution in Java, (4) *Marsdenia teysmanni* or *Tetragonocarpus teysmanni* Hassk. The plants are distributed in Bali and Java, (4) *Marsdenia celebica* or *Chlorochlamys celebica* Miq, which has distribution in Sulawesi, 5) *Marsdenia crocea* Hook f. or *Pergularia crocea* Zipp. or *Pergularia tomentosa* Span, which found in Java and Timor.

Backer and Bakhuizen (1965), Borlage (1895), Hooker (1885) conclude that Marsdenia species in Java is *Marsdenia tinctoria* or *Pergularia parviflora*, *Marsdenia crocea* or *Pergularia crocea* or *Pergularia tomentosa, Marsdenia stenocentra* or *Marsdenia villosa*, *Marsdenia teysmanni* or *Tetragonocarpus teysmanni*, and also *Marsdenia tenacissima or Marsdenia celebica*. Few information about *Marsdenia tenacissima* are available in the literature and internet.

This paper describes the characteristics, specimen photos, and clarify the identification of specimens *Marsdenia tenacissima* found in Mount Ijo Baturagung Mountains through literature. The re-discovery of the *Marsdenia tenacissima* in Batur Agung Yogyakarta needs to be disseminated to confirm biodiversity richness in Java. Many wild plants is no longer recognized both the name or its specimen despite information documented in the books of flora and herbarium hundreds of years ago by European explorers. Publication of plants species in nature are needed to check and re-check the rediscovery of flora, and to complete the data of world flora. The study would support as raw material for the basis of any applied fields.

The research objective is to present a description of the morphological characteristics of leaves, stems, flowers, pollinia, and fruit of *Marsdenia tenacissima* of

Candi Ijo Mountains Baturagung as for identification verification.

Materials and Methods

Equipments and materials

Equipment for observation and collection comprises: digital camera Sony NEX F3, digital cameras Sony Cyber-Shot DSC-W180 digital camera Canon DSLR, rulers, micrometers, calipers, plastic container, scissors, cutter, label paper , GPS (Global Positioning System), dried herbarium collection equipment, bottles, stereo microscope Nikon SMZ 1500 equipped with a camera, Nikon light microscope equipped with Nikon Eclipse 50 DSF1. Materials for observation and collection comprises: Aquadest, Alcohol 70%, FAA solution (Formalin Acetic Alchohol).

Procedures

1. Observe and take macro and microphotograph of specimen under natural conditions at the site, herbarium, and flower detail.
2. Preparation of dried herbarium
3. Early identification of specimens for members Asclepiadaceae based on the book Flora of Java Vol. 2 (Backer and Bakhuizen, 1965).
4. Identify Asclepiadaceae specimen based on existing literature, including checking and matching with herbarium type.

Results and Discussion

On December 16 exploration, author found gummy vine with fine hair on dorsal surface of the leaves. The authors predict that this plant belong to family Apocynaceae and sub family Asclepiadoideae. On further observation at the end of December, aditional data on bud and flower were obtained. The location of the plant was on the shrubs at the site of S 07 ° 47 '03.4 "; E 110o 30 '48.0 "at an altitude of 415 m DPL (Widodo, 415 m DPL, December 31th 2012).

Identification using Flora of Java, Vol. 2 (Backer and Bakhuizen, 1965) concluded that this plant is Marsdenia. Subequent observations on January 4, January 19, and January 29, 2013 obtained data about the twigs and flowers structure (Figure 1 A, B, C, D, E; Figure 2A, B, C, D), Specimen collection process is carried out in the laboratory for continued observation. On March 21, 2013 author found the young fruit (Figure 3A).

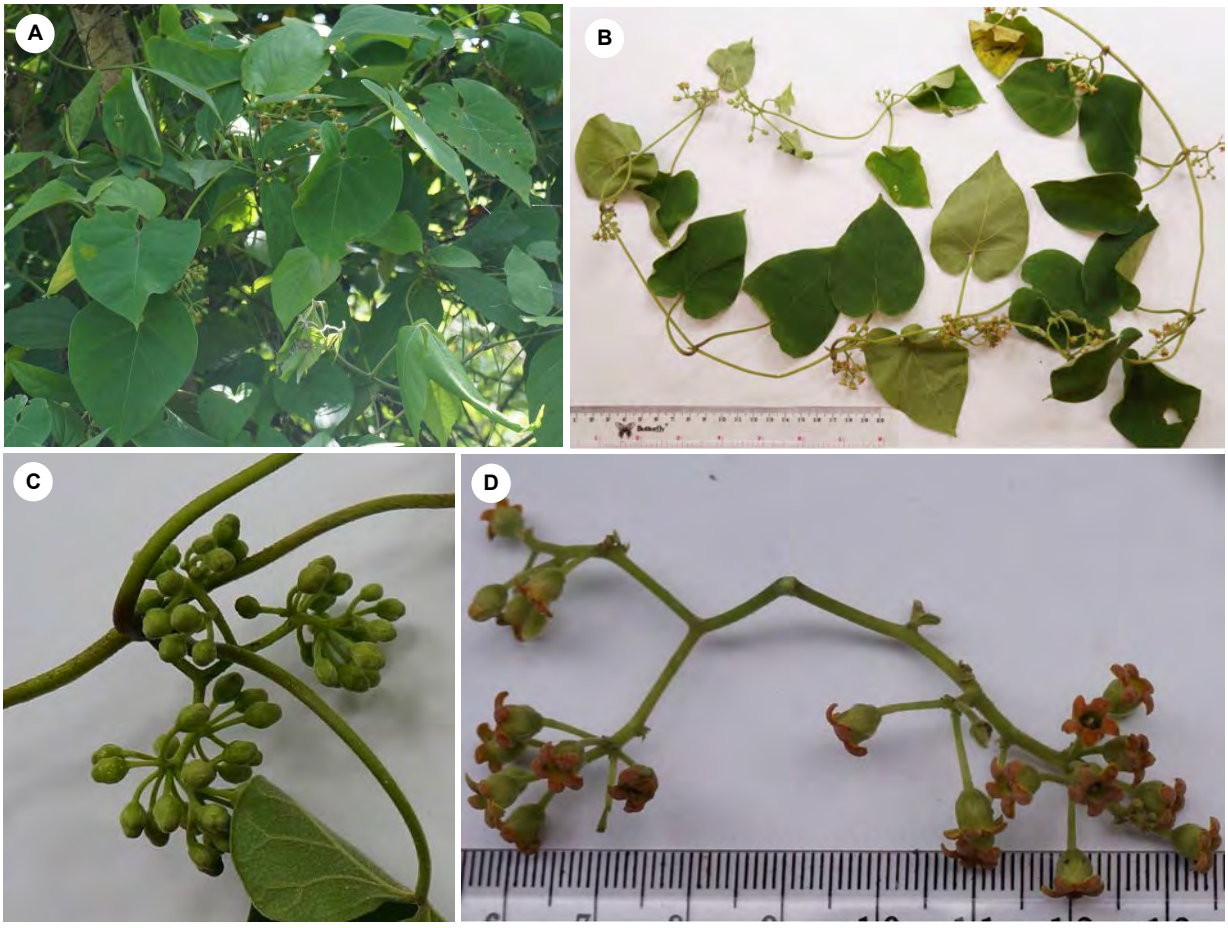

Figure 1. *Marsdenia tenacissima* found by author on Gunung Ijo. A. Habitus in nature. B. Flowering twigs. C. Flowering buds. D. Inflorescences.

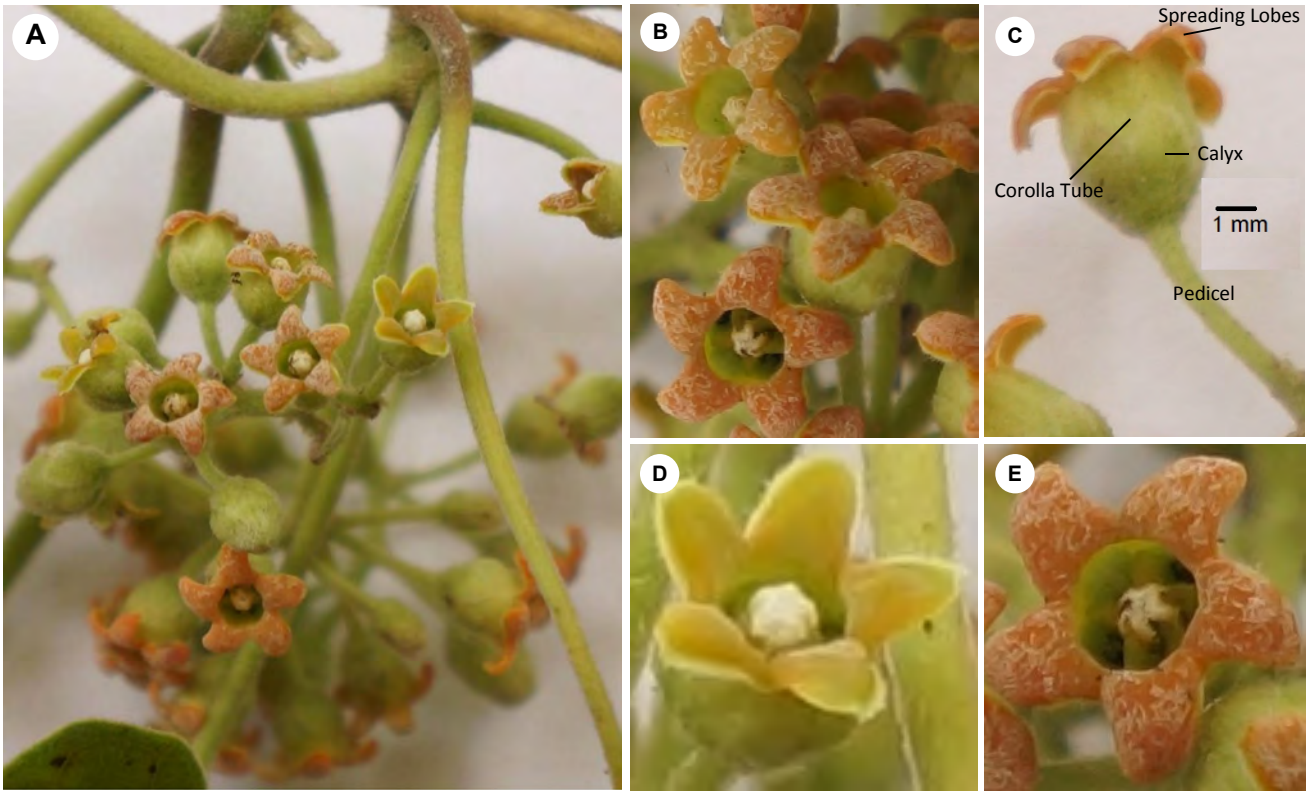

Figure 2. *Marsdenia tenacissima* flower. A. Arrangement of Inflorescences. B. Flower Unit, Top View. C. Parts of Fower Unit, Lateral View. D. Blooming Flower. E. Flower Completely bloom.

This Marsdenia shows characteristics of *Marsdenia crocea* (Zipp. Ex Span.) Hook. F. Ex Boerl as described Flora of Java, Vol. 2 (Backer and Bakhuizen, 1965) with little difference in the length of the petiole and the color when the crown of flowers in full bloom. Long petiole (petiolus) specimens ranging from 3-7 cm, while Backer and Bakhuizen (1965) describes the length of the petiole is only 3 cm. Corolla has yellowish color to the reddish-brown yellow flowers in full bloom after folding along the crown out towards the end of basalt. Backer and Bakhuizen (1965) described Marsdenia crocea as shown in Table 1.

Identification using the book Flora of British India (Hooker, 1885) and Flora of China (1995) showed that the characteristics of stem, leaf, and flower of Marsdenia from Gunung Ijo match to *Marsdenia tenacissima*. Description of Hooker (1885) and Flora of China (1995) on Marsdenia tenacissima shown in Table 2. The characteristics of *Marsdenia tenacissima* flowers specimens from Gunung Ijo match with the description of Flora of China (1995).

Table 1. Description of Backer & Bakhuizen (1965) on *Marsdenia crocea.*

Plants parts	Description
Flower, Pollinia	Fre part of corona-scales narrowly ovate, obtuse, reaching to about half the height of the stigma; back of connate part ridge shaped, opened towards the base; translators several times shortter than pollinia; panicles broadly pyramidal, c. 5 cm long; pedicels 5-7 mm; calyx c. 3 mm; segments ovate-elliptic, obtuse; corolla c. 6 mm, yellowish white, outside more densely hairy in the upper half than the lower; tube on the side with basal tufts on long hairs, c. 3,5 mm long; segments glabrous inside, with a thickened rim at the base (in the throat), c. 2,5 mm long; gynostegium subequalling the corolla-tube; stigma broadly conical, obtuse.
Leaves	Leaves cordate, shortly acuminate, thinly grey-pubescent above, more densely so above, palmatinerved, with distint lateral nerves, finely reticulate-veined, 5-10 cm by c. 6 cm; petiole c. 3 cm.
Information	Very long ago collected in East Java

Table 2. Flora of China (1995) and Hooker description (1885) on *Marsdenia tenacissima.*

Flora of China (1995)	
Plants part	Description
Habitus	Lianas robust, densely pilose to tomentose throughout except for interior of corolla. Petiole 5–6 cm, slender; leaf blade ovate, 8–10 × 6–6.5 cm, base deeply cordate with rounded sinus, apex
Flower	acuminate; basal veins 5–7, lateral veins 2 or 3 pairs. Inflorescences much branched, broader than long, to 8 × 12 cm, many flowered; peduncle to 2 cm, shorter than first internode. Pedicel 6–8 mm. Sepals elliptic-lanceolate, ca. 3 × 1–1.3 mm, tip rounded. Corolla "yellow," campanulate, with spreading lobes, very densely pilose outside; tube ca. 3.5 × 2.5 mm, interior retrorsely pilose toward base; lobes oblong, ca. 4 × 2.2 mm, apex rounded, minutely velvety. Corona lobes exserted from corolla tube, oblong, apex truncate-emarginate with corners produced into short horns, sometimes toothed between these. Anther appendages oblong, slightly longer than corona
Pollinia	lobes; pollinia curved cylindric. Stigma head broadly cylindric, concealed by anther appendages. Cliffs; 1500 m. Yunnan (Szemoo) [Cambodia, India, Laos, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam].
Information	The stems yield very strong fibers, reputedly among the strongest produced by any plant, that are used for making cords and strings.
Hooker (1885)	
Stem	Stem very stout. Leaves 4-7 by 3-5 in., often valvaty above; petiole 2-3 in. Cymes much
Leaves	corymbosely branched. Corrolla 0,25 in. diam., lobus oblong, ciliate. Stigma beetwen conical and
Flower	dome shaped. Follicles 5-6 in. long by 1,5-2 in. diam., lanceolate; pericarp very thick,
Fruit	longitudinally wrinkled, finely pubescent. Seed ovate-oblong. 0,5 in long. *Pergularia crocea*, Zipp.

Figures 3A, B, C, DE, show *Marsdenia tenacissima* fruits of Gunung Ijo. A collection of young fruit and ripe fruit were made by the author on March 21, 2013 and August 26, 2015. Figure 3E, F, is sketch of *Marsdenia tenacissima* fruit (Flora of China, 1995). The characters of fruit and seed of Marsdenia tenacissima of Gunung Ijo match with the illustration Marsdenia tenacissima in Flora of China (1995), especially young fruit structure and seeds form.

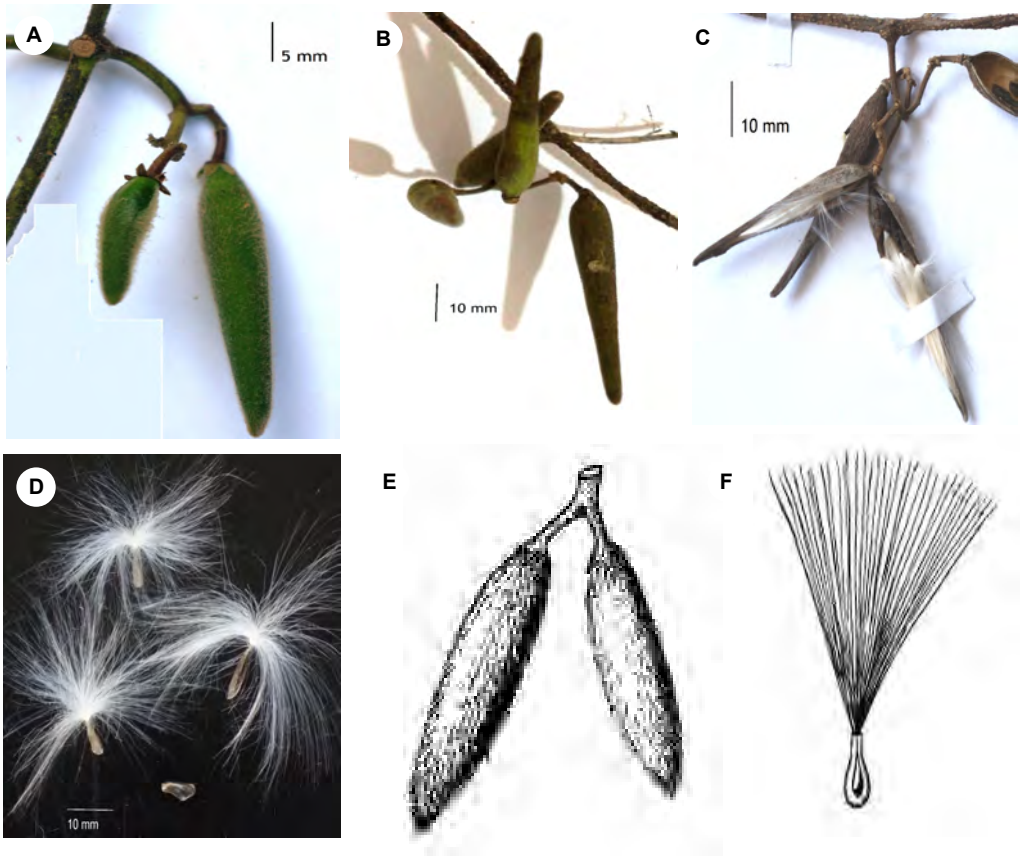

Figure 3. Fruit and seed of *Marsdenia tenacissima* from Gunung Ijo (A, B, C, D), and illustration on Flora of China (1995) (E, F). A. Young fruit. B. Mature fruit. C. Mature fruit and broken fruit. D. Seed. E. Fruit illustration. F. Seed illustration.

Figure 4A shows a comparison of the inflorescence herbarium from Gunung Ijo and from Hooker (Figure 4D) in 1863 which is collected from Bengal (MNHN P03522167), and 4E herbarium KEW (K001129150). Figure 4B, 4C is a vegetative branches and fruit herbarium from Gunung Ijo, while Figure 4F fruiting twig herbarium of Kew herbarium (K001129153).

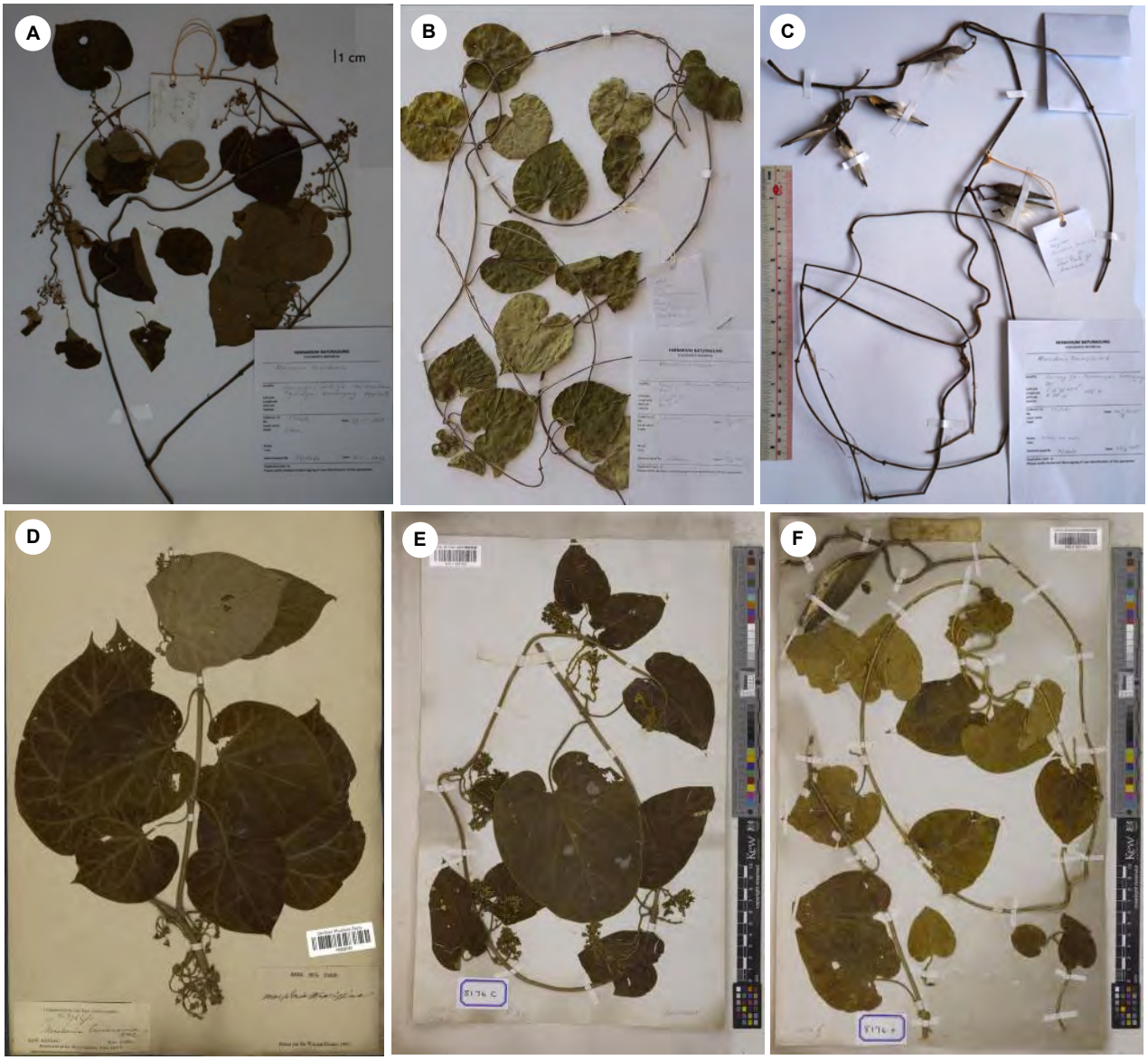

Figure 4. *Marsdenia tenacissima* herbarium from Gunung Ijo compared to KEW (A, B, C) & MNHN herbarium collection (D, E, F).

Comparison of herbarium specimens to the herbarium collections and SKEW MNHN in Figure 4 shows the similarity in the characteristic of twigs, leaves, inflorescence structure and the size of the fruit. Similarity of characteristic leaf are as follows: the heart-shaped, rounded and deep sinus at the base of the heart shape, softer hairy of adaxial surface, brighter color of the abaxial surface. The similarity of the structure of a inflorescence is cymes much corymbosely branched. The similarity of the size of the fruit is the size range of about 5-7 cm long with a width of 0.8 to 1.5 cm. Based upon the data in the field, tenacissima Marsdenia leaf size varies with length of 5-12 cm and 5-9 cm wide in a single individual. It should be noted that the qualitative characteristics of the leaves become an important marker in the identification of this species.

The similarity of the structure of the leaves, inflorescence, fruit size specimens of Gunung Ijo (Figure 4A, B, C) can be compared with Marsdenia tenacissima in herbarium collections Bogor (BO1646031, BO1646032, BO1646038, BO? Ex Herb. Koordersianum No. 16214) in Figure 5. Structure of Gunung Ijo Spesimen is similar to Figure 5D. This herbarium was from Sulawesi and was identified as *Marsdenia velutina*.

Figure 5. *Marsdenia tenacissima* in Herbarium Bogoriennse.

There is a significant difference between fruit size of specimen from Gunung Ijo (range 5-6 cm long, 0.8 to 1.3 cm wide) with size of the fruit Marsdenia tenacissima from Hooker (1885), which is 5-6 inches long and 1-1.5 inches wide. I suspect that this is an error in writing the unit.

Identification of species Asclepiadaceae (Asclepiadoideae) on the basis of morphological characteristics vegetative structures still confusing because the variation between species in the subfamily is quite high, as well as reproductive structures (flowers and fruit). Plant identification is very difficult to do in a group of plants with a number of cultivars and hybrids are large and unknown (Simpson, 2006). Therefore, it is necessary to rely the identification on the traits that have a strong character. Shape or structure of the pollinia is an important character to distinguish species in Asclepiadoideae (Sreenath, et al., 2012; Sinha & Mondal 2011).

Characteristic of pollinia of Asclepiadoidea species had been described by experts since hundreds years ago, but visualization using pictures were very rare. Structure of Gynostegium (unification pistil with the anther) are shown in Figure 6A, 6B, and the pollinia *Marsdenia tenacissima* of Gunung Ijo are shown in Figure 6D, 6E. The structure pollinia of *Marsdenia tenacissima* of Gunung Ijo are shown in thats Figure. The pollinia match to the description of *Marsdenia crocera* pollinia (Backer & Bakhuizan (1965) and a description of the Flora of China (1995) (Table 2) as well as illustrations of *Marsdenia tenacissima* gynostegium and pollinia (Flora of China, 1995) in Figure 6C, 6F.

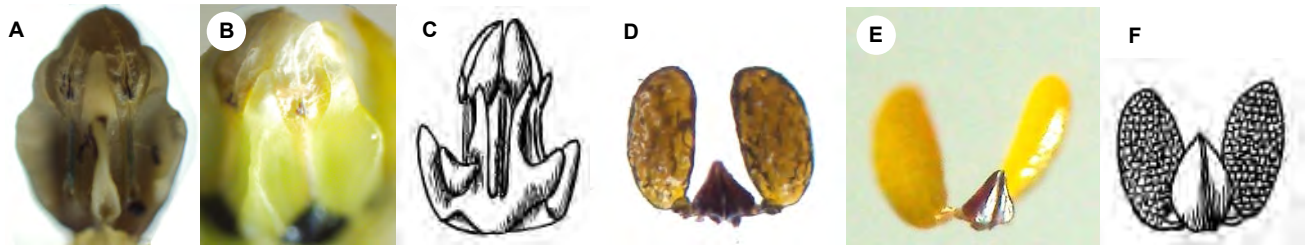

Figure 6. Gynostegium and Pollinia of *Marsdenia tenacissima.*

From the description and analysis above, it is conclude that the specimen of Marsdenia from Gunung Ijo is *Marsdenia tenacissima*. Description Hooker (1885) about the existence of *Marsdenia tenacissima* (identified by Miquel as Pergularia crocea) in Java can be justified. Marsdenia crocea described by Backer and Bakhuizen (1965) as the correction for Pergularia crocea is basically Marsdenia tenacissima. Herbarium BO1646038 Marsdenia tenacissima support the distribution of this species in Java. Backer BO1646038 herbarium is a Backer's collection from Kangean islands in 1919 and identified by Hatusima in 1945 as Marsdenia tenacissima.

The similarity of character between specimen from Gunung Ijo and BO1646031, BO1646032, BO? Ex Herb. Koordersianum No. 16214 shows that Marsdenia tenacissima also found in Sulawesi, although initially identified as *Marsdenia velutina*.

In addition to using herbarium, species descriptions and determination keys, identification of plant species need an alternative method by utilizing the digital color image files. Baskauf and Kirchof (2008) has developed a standard photo living plants as digital plant specimens. Error, Kucuker and Sik (2009) have developed an illustrations technique combined with a virtual observation and herbarium specimens for species identification and determination. Improvement and completeness of illustration data in the document and books of flora are critical to improve the works in current and future taxonomy. Colored digital image can be used to check and re-check identification.

Taxonomic Treatment

Marsdenia tenacissima (Roxburgh) Moon, Cat. Pl. Ceylon 21. 1824; *Marsdenia tenacissima* Wight & Arn., Fl. Brithis Ind. IV: 35; *Marsdenia crocea* (Zipp. ex Span.) Hook. F. Ex Boerl.; TYPE: Benggala, 1863, W. Hooker (MNHN P03522167)

Lianas robust, stem very stout densely pilose to tomentose. Petiole 3–6 cm, slender; leaf blade ovate-cordate, 4–10 × 6–6.5 cm, base deeply cordate with rounded sinus, apex shortly acuminate; thinly grey-pubescent above, more densely so above, palmatinerved, with distint lateral nerves, finely reticulate-veined, basal veins 5–7, lateral veins 2 or 3 pairs. Inflorescences much branched, cymes much corymbosely branched broader than long, to 8 × 12 cm, many flowered; peduncle to 2 cm, shorter than first internode. Pedicel 6–8 mm. Sepals elliptic-lanceolate, ovate, ca. 3 × 1–1.3 mm, tip rounded, corolla "yellow," campanulate, with spreading lobes, very densely pilose outside, 8 mm diam., lobus oblong ; tube ca. 3.5 × 2.5 mm, interior retrorsely pilose toward base; lobes oblong, ca. 4 × 2.2 mm, apex rounded, minutely velvety. Corona lobes exserted from corolla tube, oblong, apex truncate-emarginate with corners produced into short horns, sometimes toothed between these. Anther appendages oblong, slightly longer than corona lobes; pollinia curved cylindric, translators several times shortter than pollinia. Gynostegium subequalling the corolla-tube Stigma head broadly cylindric, beetwen conical and dome shaped, concealed by anther appendages. Follicles 5-6 cm. long by 1,5-2 cm. diam., lanceolate; pericarp very thick, longitudinally wrinkled, finely pubescent. Seed ovate-oblong. 0,5-0,7 mm long.

Specimens examined: Baturagung, Gunung Ijo, S 07 ^{o} 47' 03.4"; E 110^{o} 30' 48.0", Widodo, 415 m DPL, 31.12.2012

Note: *Marsdenia tenacissima* found at the site of observation twining other plant namely Annona muricata, Clausena indica, Zizipus oenoplia, Lantana camara alongside with other lianas namely Telosma puberula Asclepiadoideae, and Gymnema sylvestris. M. tenacissima was found by author while observe *Telosma puberula* and *Gymnema sylvestris*. M. tenacissima is not Mount Parangan forest about 5 km southeast of Gunung Ijo. Marsdenia tenacissima known as a traditional treatment for swelling, asthma and cancer in society of Southwestern Chinese (Li et al., 2006). Tripathi, et al. (2014) analyzed Farmakognosi of Marsdenia tenacissima include of character macroscopic, microscopic characters, physicochemical analysis, preliminary analysis of phytochemical content, and HPTLC profile. Root of Marsdenia tenacissima used for traditional medicine: antiscorbutic, urinary diseases, arthritis, heart disease, skin disease, thirst, pruritus, vomiting, intermittent fever and fever. Marsdenia tenacissima in Kerala India called Murva by local people. Murva root used as medicinal plant in the form of a single herb or mixed with other materials.

Concervation

Because the limited number of this plant at the site of the discovery and other locations, it is necessary to study their distribution status. Simultaneously herbarium collection need to be carried on preserve the specimen.

Conclusion

Marsdenia tenacissima (Roxburgh) Moon found on Gunung Ijo Mountains Baturagung Yogyakarta. Morphological characteristics stature (habitus), leaves, and flowers specimen *Marsdenia tenacissima* in Gunung Ijo show compliance with the Kew Herbarium collection Hooker in 1863 (MNHN P03522167) came from Bengal and Herbarium collections Bogoriense Backer 1919 (BO1646038) derived from Kangean Islands. The existence of *Marsdenia tenacissima* (Roxburgh) Moon in Java correct and acomplish description of Backer and Bakhuizen in the Flora of Java book on Marsdenia genus.

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