

Short Communication: Morphological study of *Fagraea ceilanica* (Gentianaceae) in Mount Nglanggeran, Yogyakarta, Indonesia

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Abstract. Widodo, Luthfi MJ. 2016. Morphological study of *Fagraea ceilanica* (Gentianaceae) in Mount Nglanggeran, Yogyakarta, Indonesia. *Biodiversitas* 17: 454-460. *Fagraea ceilanica* Thunb. population were found in the Mount Nglanggeran in Gunungkidul, Yogyakarta, Indonesia. Identification was based on the literature and herbarium specimens. The study was conducted through continued exploration and examination on specimen collection. The existence of *F. ceilanica* in Java was only described in Flora of Java by Backer and Bakuizen van den Brink (1965). *Fagraea ceilanica* is a liana climbing on large stone. Characteristic for initial identification were ovate to ellipsoid leaves which were opposite, thick and grayish green; bell-trumpet flower shape with flowering season around March and whitish to yellowish color and also 5-8 cm corolla tube. This paper presents important morphological character, namely leaves, stems, flowers, and fruits of *F. ceilanica*. Study on morphological character of *F. ceilanica* found on Mount Nglanggeran is needed to recognize its potential, benefit and conservation of this species.

Keywords: *Fagraea ceilanica*, Gentianaceae, Mount Nglanggeran, Yogyakarta

INTRODUCTION

In exploration, observation and assessment of wild plants in the Mount Nglanggeran Gunungkidul, Yogyakarta, Indonesia in August 2009; the authors collect liana plants climbing on the rocks with thick leaves and crossed opposite leaf arrangement. The plant was found on main track in S.07.50,319°; E.110.32,186°, 441 m. The authors had difficulty in identifying the species or family of the plant. Through many visits and observations, data were obtained. The process of identification through literature and herbarium study found that these plants are *Fagraea ceilanica* Thunb.

Fagraea is a genus belongs to Gentianaceae family (Takhtajan 2009) while Backer and Bakuizen van den Brink (1965), Kochummen (1972), Keng (1994), and Steenis (1972) state that this genus belongs to Loganiaceae family. Gentianaceae and Loganiaceae family belong to Gentianales order in Euasterid I clade (APG III 2009). According to The Plant List (2013), *Fagraea* genus belongs to Gentianaceae family. Note: according to the International Plant Names Index (IPNI) (2010), there are 72 species belonging to *Fagraea* genus. Kochummen (1972) states that *Fagraea* genus comprises about 35 species and some 16 species are in Malaysia. Backer and Bakuizen van den Brink (1965) described 7 species member of *Fagraea* genus found in Java, namely: *Fagraea auriculata* Jack, *Fagraea fastigiata* Bl., *Fagraea fragrans* Roxb., *Fagraea racemosa* Jack ex Wall., *Fagraea elliptica* Roxb., *F. ceilanica*, and *Fagraea blumei* G. Don. Hassler (2016) informed that the distribution of *Fagraea ceilanica*

including China (Guangdong, Guangxi, Hainan, Yunnan), Taiwan, Cambodia, India, Darjeeling, Laos, Burma, Thailand, Vietnam, Java, New Guinea (alpine), Sri Lanka, peninsular Malaysia (Kelantan, Perak, Pahang, Selangor, Johor), India (Assam), Deccan, Sumatra, Borneo, Sulawesi, Lesser Sunda Isl., Moluccas, New Guinea, Philippines (throughout).

Leaf characteristics, life forms, and corolla tube size of *Fagraea* in Nglanggeran are in accordance with the description of Backer and Bakuizen van den Brink (1965) concerning *F. ceilanica*. According to Backer and Bakuizen van den Brink (1965), *F. ceilanica* is the same type as *Fagraea litoralis* Bl. and *Fagraea obovata* Wall. Based on illustrations (Blume 1836), *Fagraea* of Mount Nglanggeran have the same characteristics with *Fagraea coromandelina* Wight, while the characteristics of the leaves and stems are in accordance with *F. ceilanica*, traits of fruit are in accordance with *F. litoralis*, *F. ceilanica*, *F. obovata*. Based on herbarium specimens from Nglanggeran, the plants have similarity with *F. coromandelina* that lately identified as *F. ceilanica*. According to The Plant List (2013), *F. ceilanica* is synonymous with *F. coromandelina*, *Fagraea gardneri* Thwaites, *Fagraea khasiana* Benth., *Fagraea malabarica* Blume, *F. obovata*, *Fagraea prainii* Gand., *Fagraea rostrata* Blume, and *Fagraea sasakii* Hayata. It is needed to check the identification of Nglanggeran *Fagraea* as well as the accuracy of the statement about *Fagraea* synonymous.

This paper presented a detailed description of the characteristics of the plant and herbarium specimens of

Fagraea from Mount Nglanggeran completed with illustrations/pictures, herbarium types and descriptions in the existing literature to clarify the identification. *Fagraea* species discoveries in the Mt. Nglanggeran, Baturagung Mountains, Yogyakarta needs to be disseminated to present the status of flora in Java. The status of flora in Java, especially non-cultivated plants, is now no longer recognized either by its name or its specimen despite documented in the books of flora and herbarium hundreds of years ago by European explorers. Publication of species of plants in nature is required to complete the data of world's flora, re-check and rediscovery of the flora, and to improve and recheck the description of the characteristics for a further research on biodiversity of plants, plant structure, and plant systematic. The study of biology is the basic material to support the activities of conservation and exploration of earth sustainable plant use.

MATERIALS AND METHODS

Study area

This research is primarily conducted in the climbing track area of mount Nglanggeran that is the ecotourism region in Gunungkidul, Yogyakarta Province, Indonesia (Figure 1). This study uses continuous exploration visits (exploration and collection trip) (Singh 2010). The image is taken for the first step of identification. The sample specimens for the herbarium are also brought home with regard to the sustainability of the population. Along with the identification process, observation on inflorescence and fruit formation are carried out.

Equipments and materials

Equipment for observation and collection comprises: digital cameras of Sony NEX F3, Sony Cyber-Shot DSC-W180 and Canon DSLR, rulers, micrometers, calipers, roll meter, plastic collection, scissors, cutter, label paper, GPS

(Global Positioning System), dried herbarium collecting equipment, bottles, stereo microscope Nikon SMZ 1500 equipped with a camera, Nikon light microscope equipped with Nikon Eclipse 50 DSF1. Specimen collection procedure implemented with dried herbarium method refers to Simpson (2006) and Singh (2010). Herbarium specimens deposited by the authors in the Universitas Islam Negeri Sunan Kalijaga, Yogyakarta, Indonesia (Herbarium Baturagung, BAW50III16A1).

Methods

Plant image at the site, dried herbarium, pictures of flowers/fruit, making of herbarium dried, shooting dried herbarium specimens, observation of the structure plant, are identified, checked and matched with herbarium catalogue of Royal Botanic Gardens, Kew (K), (<http://www.kew.org/herbcat>) (RBGK 2015), Muséum National d'Histoire Naturelle, Paris (France) Collection of Vascular Plants (P) (<http://coldb.mnhn.fr/catalognumber/mnhn/p>) (NMHN 2016), Backer and Bakhuizen van den Brink (1965), Steenis (1972), and Kochummen (1972).

RESULTS AND DISCUSSION

The observation and assessment of the initial specimen by the authors on exploration of wild plants in Mount Nglanggeran Yogyakarta since August 2009 found a kind of liana plants that climbing a rock. This plant is interesting because it has thick leaves like bark, obovate to elliptic leaf shape, unclear bone on secondary leaves, and face crossed leaf arrangement. These plants often grow together with *Hoya* sp. and leaf morphology of both plants has similarities. In exploration on February 2012, authors found flowering plants in the location S.07.50,319°; E.110.32,186°, 441 m. Later, on the April 2012, the plant had young fruit and on August 2012, the fruit was in a state of its maximum size.

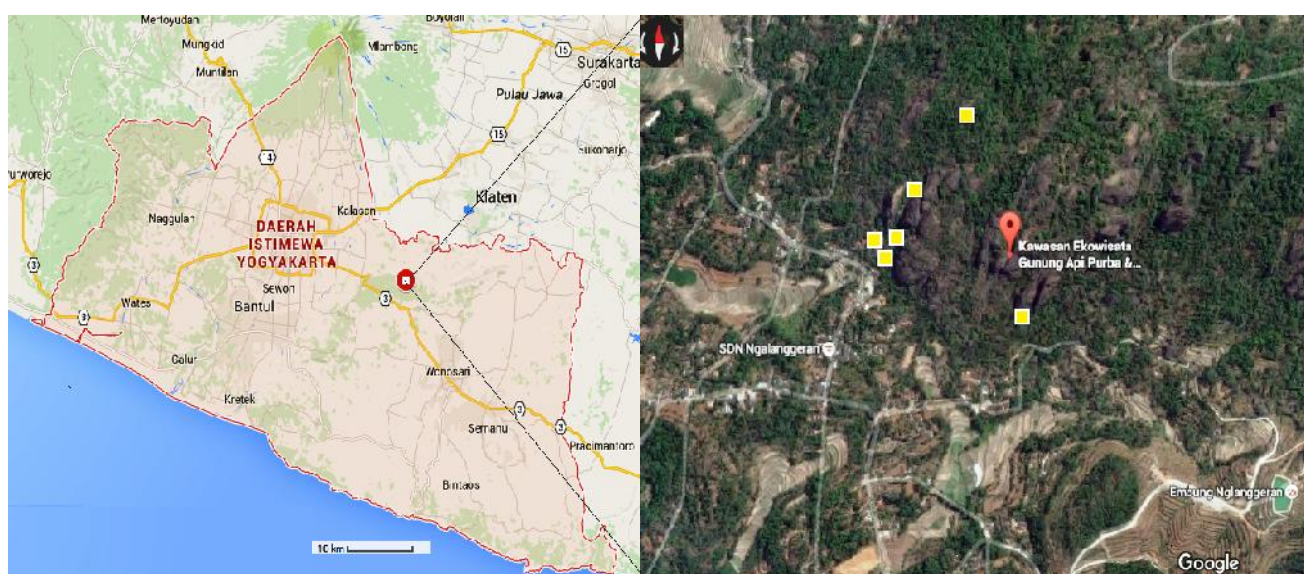


Figure 1. A. Yogyakarta province, B. The western part of Mount Nglanggeran in Gunungkidul (■ = *Fagraea ceilanica* location)

Identification using Backer and Bakhuizen van den Brink (1965) concluded that this plant is *Fagraea*. This *Fagraea* shows characteristics of *F. litoralis* or *F. obovata* or *F. ceilanica*. Figure 2 shows a specimen of *F. ceilanica* of Mount Nglanggeran. Description of *F. ceilanica* by Backer and Bakhuizen van den Brink (1965) are shown in Table 1.

Compared to descriptions by Backer and Bakhuizen van den Brink (1965), *F. litoralis* or *F. obovata* or *F. ceilanica* that is found in Mount Nglanggeran has a longer corolla tube sizes which is about 4-8 cm, while the smaller fruit size is about 3 cm long. According to Slik (2016), *F.*

ceilanica can have variations in the size of 2-5 cm with the shape of crown tube, such as variation found in Sri Lanka, and of 8.5-10 cm, such as variation found in southwest Decan (India), the variation in length of 3-5 cm and in Assam (India) only 1.8 cm.

Herbarium specimens of Mount Nglanggeran *Fagraea* are shown in Figure 3A. Based on the information of Backer and Bakhuizen van den Brink (1965), herbarium of *Fagraea* from Mount Nglanggeran is identical to type of herbarium of *F. litoralis* or *F. obovata* or *F. ceilanica* (Figure 3.B, 3.C). Information from The Plant List (2013) and the Catalogue of Life (2016) was that *F. ceilanica* also

Table 1. Description of *Fagraea litoralis* Bl. or *Fagraea obovata* Wall or *Fagraea ceilanica* Thunb. (Backer and Bakhuizen 1965)

Part	Description
Character	Flower is much larger Nerver of leaves are obsolete
Leaves, petiolus	Leaves are elliptic to oblong, thick coriaceous, acute base, acuminate apex, 5-15 cm, 2-9 cm; ½-3 cm petiolus; axillary which is small scale, rounded, appressed and against the twig,
Habitat, habitus	Ephytic, 3-15 m height, flowering on January-June, 0-1700 m asl of forest, forest edges, secondary forest, bushes, beaches, littoral cliff.
Flower, fruit	small Inflorescences, subsessile, few flower, campanulate calyx, 1-1 ¾ cm long, over ¼-1/2 cm, conate; corolla slender, th trumpet shape, 2 ½-5 cm tube, stamen and style which are not much exerted from the throat; ½-¾ cm anther, variate stigma, fruit ellipsoid to globose, 3-5 cm, sordidly white, lobes patens calyx.
Distribution in Java	West, Central and East Java

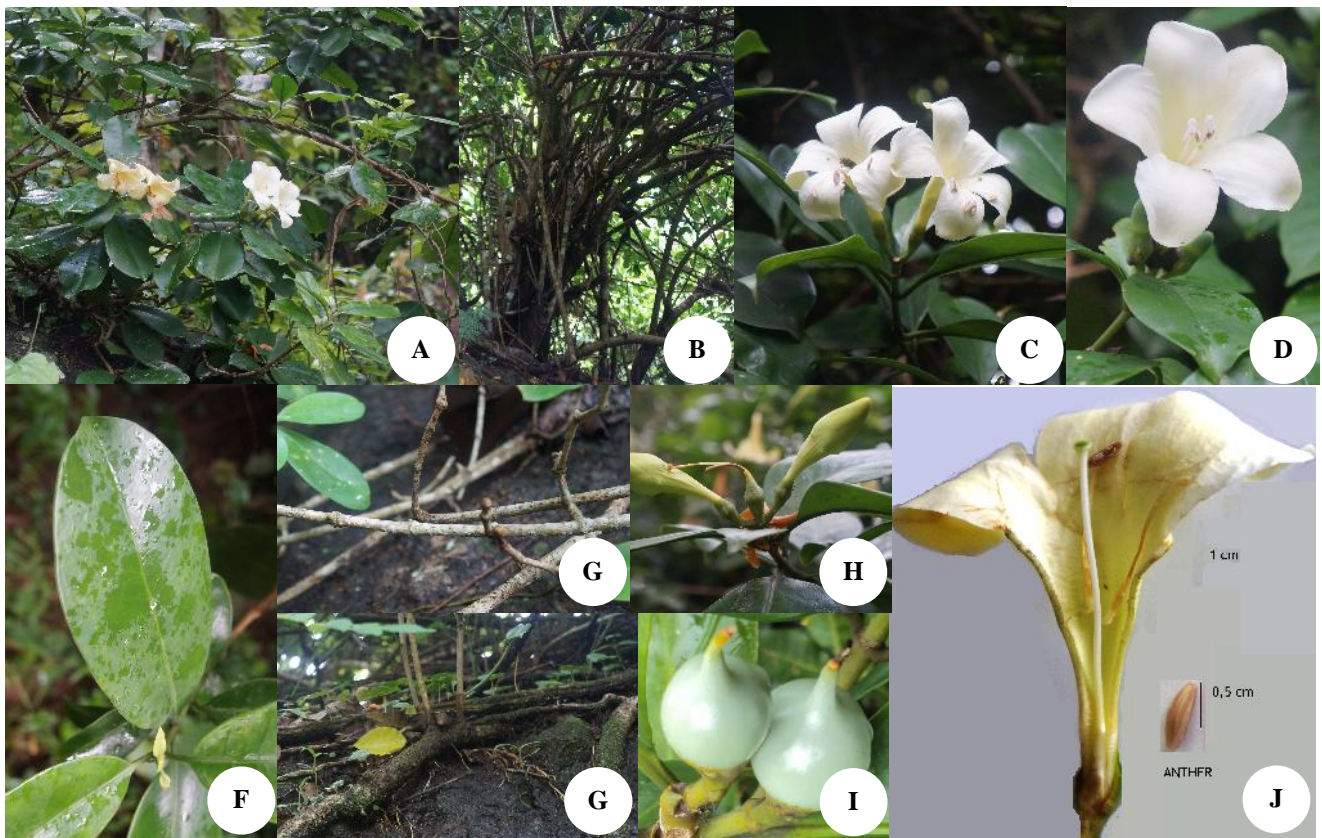


Figure 2. *Fagraea ceilanica* form Mount Nglanggeran, Yogyakarta, Indonesia. A. Habitus, B. Stem, C. Inflorescence, D. Flower, E. Leaf, F. Branch, G. Root, H. Cymose Inflorescence, I. Fruit, J. Section of flower

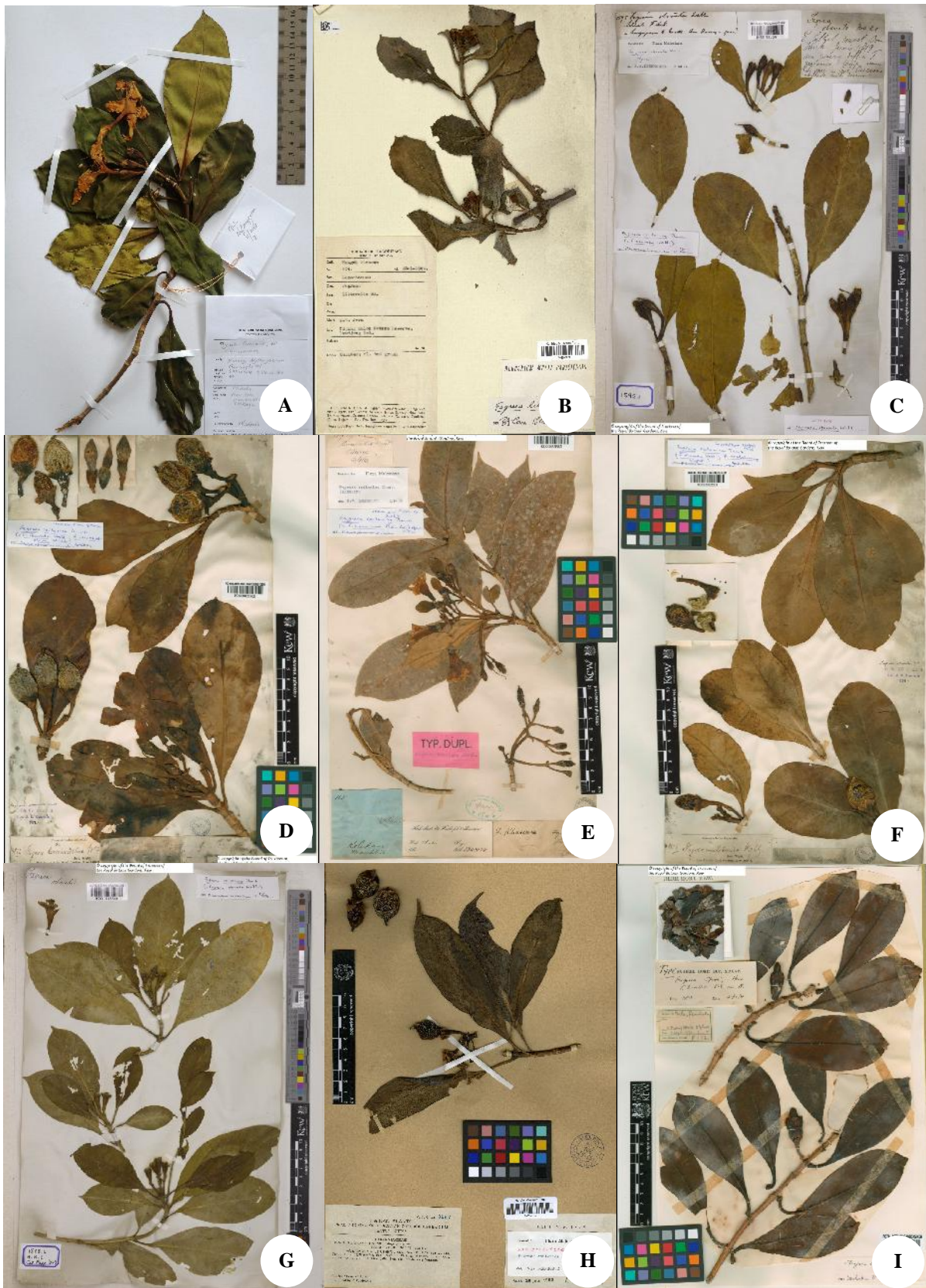


Figure 3. Comparison of herbarium of *Fagraea* of Mount Nglanggeran (A) with herbarium type *Fagraea ceilanica* (B, C, D, E, F, G, H, I). A. Herbarium *Fagraea* from Mount Nglanggeran (BAW501III16A1), author collection. B. *Fagraea litoralis* Bl., MNHN-BO (P0456462), C. *Fagraea obovata* revised to *Fagraea ceilanica*, KEW (K001113547), D. *Fagraea coromandelina* revised to *Fagraea ceilanica*, KEW (K000883562), E. *Fagraea khasiana* revised to *Fagraea ceilanica*, KEW (K000883560), F. *Fagraea malabarica* revised to *Fagraea ceilanica*, KEW (K000883561), G. *Fagraea obovata* revised to *Fagraea ceilanica*, KEW (K001113549), H. *Fagraea chinensis* revised to *Fagraea ceilanica*, MNHN (P00349420), I. *Fagraea lanceolata* revised to *Fagraea ceilanica*, KEW (K00438439).



Figure 4. Comparison photograph of the *Fagraea ceilanica* from Mount Nglangeran (A, B, C, D) with ancient botanical illustration (D, E, F, G, H). A. Terminal inflorescence, B. Characteristic of flower buds, C. Corolla, D. Young fruits, E. *Fagraea ceilanica* (Curtis's Botanical Magazine, vol. 100 [ser. 3, vol. 30]: t. 6080 (1874) [W.H. Fitch]), F. *Fagraea obovata* (Curtis's Botanical Magazine, vol. 72 [ser. 3, vol. 2]: t. 4205 (1846) [W.H. Fitch]), G. *Fagraea coromandelina* (Beddome, R.H., The flora sylvatica of southern India, vol. 2: t. 244 (1869-1874) [Govindoo]), H. *Fagraea malabarica* (Wight, R., Icones Plantarum Indiae Orientalis, vol. 4(2): t. 1317 (1846) [Govindoo]), I. *Fagraea litoralis* (Blume, C.L., Rumphia, vol. 2: t. 74 (1836)), J. *Fagraea lanceolata* (Blume, C.L., Rumphia, vol. 2: t. 77 (1836)).

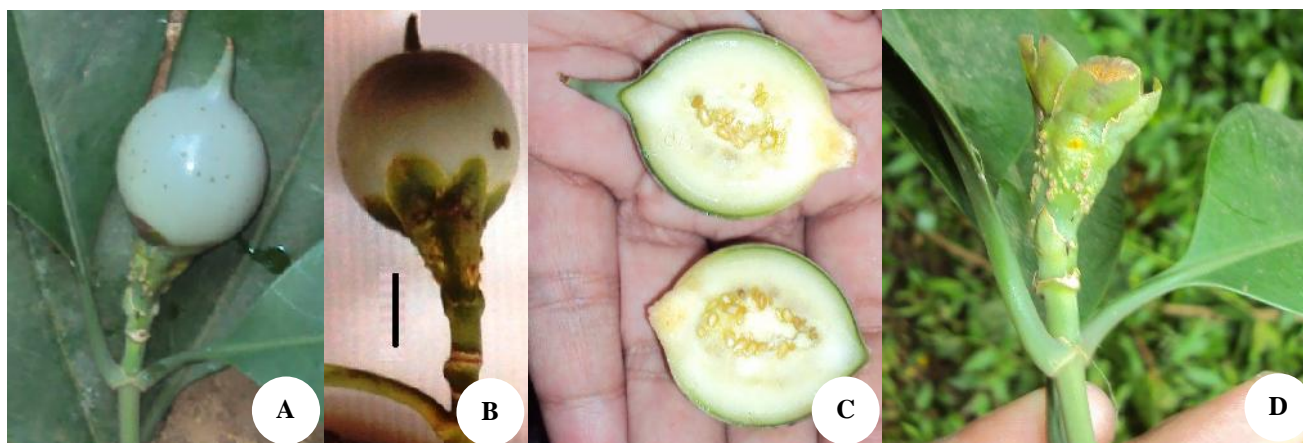


Figure 5. Fruit of *Fagraea* from Mount Nglanggeran. A. Fruit shape, B. Fruit section, C. Characteristic of fruit stalk

had similarity with *F. coromandelina*, *F. khasiana*, *F. malabarica*, *F. obovata*, *Fagraea chinensis* Merr. Herbaria which is shown in Figure 3. D, E, F, G, H, I. According to The Plant List (2013), *F. litoralis* is identical to *Fagraea lanceolata* Bl. Herbarium *F. lanceolata* from Singapore can be observed in Figure 2.I. However, synonymy *F. litoralis*, *F. obovata*, *F. coromandelina*, *F. khasiana*, *F. chinensis*, *F. malabarica* to *F. ceilanica* have a remarkable consequence. If all the synonyms belong to *F. ceilanica*, it is ignoring the wide variety of all synonyms that occur consistently all over the world.

From comparison with herbarium, it is concluded that type of Mount Nglanggeran *Fagraea* have similarity with herbarium *F. coromandelina*, especially in terms of flower size. *Fagraea*, herbarium of Mount Nglanggeran, have flowers with a relatively large size compared to other herbaria. It has cymose inflorescence with fewer flower units (3 or 5). Figure 4 shows a comparison photograph of the Mount Nglanggeran *Fagraea* specimen with ancient botanical illustration.

From the comparison, it appears that *Fagraea* of Mount Nglanggeran are more resemblance to the *Fagraea coromandelina* in term of flower buds and the inflorescences structure. Flower size of a Mount Nglanggeran *Fagraea* is relatively accordance with *F. ceilanica*, *F. obovata*, *F. coromandelina* and *F. malabarica*. Morphological structure of fruit and fruit color of Nglanggeran *Fagraea* (Figure 5) are equal to *F. litoralis* and *F. lanceolata*, *F. coromandelina* (Figure 4 I, J; Figure 3.G). Herbarium types of *F. ceilanica* in the herbarium center KEW and MNHN obtained from this research did not exist. Herbarium *F. ceilanica* is a reidentification of *F. obovata*, *F. khasiana*, *F. coromandelina*, *F. malabarica*, *F. litoralis*, *F. chinensis*, and *F. lanceolata*. Based on the characteristics of herbarium and ancient illustrations (Antheunisse 2016) on *Fagraea*, the author identifies *Fagraea* of Mount Nglanggeran as *F. ceilanica* ssp. *coromandelina*.

From the discussion above, the findings of *Fagraea* of the Mount Nglanggeran, need further examination to become the basis of re-identification of herbarium

specimen types. There is a high diversity of traits among herbarium types of *F. ceilanica*. The name or identity of the species in the old manuscript illustration or early herbarium should be considered carefully to correct the identification of herbarium specimens. In the case of this *Fagraea*, early authors' illustrations and identification has higher accuracy rate than the present existing identification. Herbarium is an important base in identifying and determining the identity of the plant.

Taxonomic information

Fagraea ceilanica Thunb., Kongl. Vetensk. Acad. His Handl. 132. 1782; *Fagraea coromandelina*. Type: Indian Peninsular, 1812. Wight. KEW K0005883562.

Description

Climber or small tree, epiphytic shrub. Simple, opposite, decussate leaves which are clustered at end of branchlets, elliptic to oblong, thick-coriaceous, acute base, acute and acuminate apex, 5-15 cm by 2-9 cm; ½-3 cm petiole, obsolete nerves, raised midrib; secondary nerves obscurely visible, tertiary and higher order nerves not visible; small scale, rounded, appressed against twig, subconnate axillary. Inflorescences, terminal cymes, subsessile, few flower, 3-5; large flowers, campanulate calyx, 1-1 ½ cm long, connate, slender corolla, trumpet shape; 3-5 cm tube; yellow outside and white inside petals; stamen and style are not much exerted from the throat; ½-¾ cm anther; green stigma; ellipsoid to globose fruit, 3-4 cm, sordidly white green, lobes patent calyx.

Note

Fagraea ceilanica in Mount Nglanggeran are flowering on February-March.

Conservation

The existence of this plant at the site is threatened by human activity due to the increased interest in the site as a tourist destination. It is necessary to the provision of adequate information to the community about the position this plant in local ecosystems.

In conclusion, *F. ceilanica* are found on Mount Nglanggeran Yogyakarta. Morphological characteristics stature (habitus), leaves, twigs, flowers of *F. ceilanica* from Mount Nglanggeran show similarity to *Fagraea coromandelina* collection of Wight (1812) from India (KEW K0005883562). The existence *F. ceilanica* on Mount Nglanggeran complements and recovers the description of Backer and Bakhuizen van den Brink (1965) about *F. ceilanica*.

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REFERENCES

- Antheunisse M. 2016. *Fagraea*. In: Plant Illustration, Version 4.0. <http://plantillustrations.org/taxa.php?taxon=Fagraea> [10 Mei 2016].
- APG III [Angiosperm Phylogeny Group]. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Bot J Linn Soc* 161 (2): 105-121.
- Backer CA, Bakhuizen van den Brink Jr RC. 1965. *Flora of Jawa (Spermatophytes Only) (Vol II)*. N. V. P. Noordhoff, Groningen.
- Beddome RH. 1869-1874. *Fagraea coromandelina*. The flora sylvatica of southern India, vol. 2: t. 244.
- Blume CL. 1836. *Fagraea littoralis*. *Rumphia*, vol. 2: t. 74, 77.
- Catalogue of Life. 2016. Catalogue of Life: 2016 Annual Checklist. Annual Checklist Interface v1.9 r2126ab0 developed by Naturalis Biodiversity Center, The Nederland for The Species 2000 of ITIS. <http://www.catalogueoflife.org/annual-checklist/2016/>
- Fith WH. 1846. *Fagraea ceilanica*. *Curtis's Bot Mag*, vol. 72 [ser. 3, vol. 2]: t. 4205.
- Fith WH. 1874. *Fagraea ceilanica*. *Curtis's Bot Mag*, vol. 100 [ser. 3, vol. 30]: t. 6080.
- Hassler M. 2016. World Plants: Synonymic Checklists of the Vascular Plants of the World (version Feb 2016). In: Roskov Y, Abucay L, Orrell T, Nicolson D, Kunze T, Flann C, Bailly N, Kirk P, Bourgoin T, De Walt RE, Decock W, De Wever A (eds). *Species 2000*. Naturalis, Leiden & ITIS Catalogue of Life. www.catalogueoflife.org/col. [28 April 2016]
- IPNI [International Plant Names Index]. 2010. *Fagraea*. <http://www.ipni.org/ipni/idPlantNameSearch> [10 Mei 2016].
- Keng H. 1994. *The Concise Flora of Singapore: Gymnosperms and Dicotyledons*. Singapore Science Centre, National University of Singapore, Singapore.
- Kochummen KM. 1972. *Fagraea*. In: Whitmore TC (ed). *Tree Flora of Malaya*. Longman, Kuala Lumpur.
- MNHN [Herbarium Museum National d' Histoire Naturelle Paris]. 2016. *Fagraea ceilanica*. <http://www.catalogueoflife.org/col/details/species/id/8684a1b4761609c1085ad1aa4ad54889>. [10 Mei 2016].
- RBGK [Royal Botanic Garden, Kew]. 2015. *Fagraea ceilanica*. <http://specimens.kew.org/herbarium/K000438439>. [10 Maret 2016].
- <http://specimens.kew.org/herbarium/K000883562>. [10 Maret 2016].
- Simpson MG. 2006. *Plant Systematics*. Elsevier, Amsterdam.
- Singh G. 2010. *Plant Systematics*. Science Publishers, Jersey.
- Slik JWF. 2016. *Fagraea*. In: *Plants of Southeast Asia*. http://www.asianplant.net/Gentianaceae/Fagraea_ceilanica.htm [10 Maret 2016].
- Steenis CGGJ van. 1972. *The Mountain Flora of Java*. E.J. Brill, Leiden.
- Takhtajan A. 2009. *Flowering Plant*. Springer, St. Petersburg.
- The Plant List. 2013. Version 1.1 (September 2013). Published on the Internet; <http://www.theplantlist.org/tpl/search?q=Fagraea>. [10 March 2016].
- Wight R. 1846. *Fagraea malabarica*. *Icones Plantarum Indiae Orientalis*, vol. 4 (2): t. 1317.