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Diversity and conservation of Indonesian *Hoya* (Apocynaceae) in the Bogor Botanic Gardens

Keragaman dan konservasi *Hoya* (Apocynaceae) Indonesia di Kebun Raya Bogor

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Abstrak. *Rahayu S. 2018. Keragaman dan konservasi Hoya (Apocynaceae) Indonesia di Kebun Raya Bogor. Pros Sem Nas Masy Biodiv Indon 4: 291-295.* Marga *Hoya* (Apocynaceae, Asclepiadoideae) telah populer sebagai tanaman hias di Eropa, Amerika Serikat dan Australia, sementara di Indonesia yang merupakan negara paling kaya dengan jenis Hoya masih belum banyak diperhatikan. Beberapa jenis mengalami kelangkaan karena kerusakan habitat. Sejak tahun 1995, strategi konservasi ex situ telah dilakukan di Kebun Raya Bogor melalui (i) inventarisasi jenis (ii) pengelolaan koleksi hidup (iii) dan pengembangan pemnafaatan secara lestari. Hasil penelitian terhadap herbarium dan literatur menunjukkan setidaknya terdapat sekitar 100 jenis Hoya di Indonesia. Hal yang menyulitkan adalah belum ada revisi menyeluruh dari marga Hoya. Setidaknya terdapat sekitar 60 an jenis sudah dikonservasikan di Kebun Raya berdasarkan hasil eksplorasi selama 23 tahun (1995-2018). Saat ini tiga species baru sudah dipublikasikan dan akan segera menyusul setidaknya 10 spesies baru berasal dari Indonesia. Dalam pengembangannya sebagai tanaman hias, satu varoetas baru juga telah dihasilkan sebagai hasil riset pemuliaan melalui radiasi. Beberapa jenis diketahui mudah beradaptasi dalam lingkungan Kebun raya Bogr, namun beberapa jenis mengalami kegagalan. Pemeliharaan secara ex-situ membutuhkan pengembangan teknik budidaya yang sesuai untuk masing masing jenis. Promosi sebagai tanaman hias di Indonesia perlu mendapat perhatian dan prioritas.

Keywords: domestikasi, konservasi ex-situ, pengembangan tanaman hias lokal

Abstract. *Rahayu S. 2018. Diversity and conservation of Indonesian Hoya (Apocynaceae) in the Bogor Botanic Gardens. Pros Sem Nas Masy Biodiv Indon 4: 291-295.* The genus *Hoya* (Asclepiadaceae) has become popular as exotic ornamental plant in Europe, USA, and Australia, while in Indonesia as the home country of many *Hoya* species is still neglected. Several species are rare due to habitat loss. Since 1995, an ex-situ conservation strategy has been conducted in Bogor Botanic Garden. Three main activities have been done. They are (i) Inventory of Indonesian *Hoya* species, (ii) Living collection management, (iii) Sustainable Utilization. Approximately 100 *Hoya* species occur in Indonesia, concluded from literature and Herbarium studies. Unfortunately, revision of this genus doesn't do well and is still incomplete. 66 species have been collected in Bogor Botanic Garden as a result from Flora Explorations during the 23 years (1995-2018), three species published as new species, and 11 more new species will be published soon, and a new variety relusted from mutation breeding registered and hold a Plant Variety Protection (PVP) right. During their adaptation in The Bogor Botanic Garden, some species were unsuccess. The propagation techniques still need developing, as the different species may need different treatment. Promotion as an ornamental plant is the first utilization on Indonesian *Hoya* species is recommended.

Keywords: Diversity, domestication, ex-situ conservation, *Hoya*, utilization

INTRODUCTION

Established in 1817, The Bogor Botanic Garden is known as one of the oldest Botanic Garden in the world. As a center for Plant Conservation Institution in 2001, the roles of the Garden become more important. The plant conservation played by Botanic Garden is not only to save the plant germplasm (species category), but also to study botany and plant ecology, particularly on the endangered and rare plants. Besides, The Bogor Botanic Garden in the past played an important role in the domestication and introduction of some important economic tropical crops. This historical role is still relevant to the term 'plant conservation' now. 'Plant conservation' does not only save the plant germplasm but also include sustainable utilization. Many Indonesian plant species are still waiting to study and promote as new economic crops. Ideally, most of the Indonesian flora diversity would safely grow in this Garden. Then, some research and observation can be conducted on the living collection in order to study biology and promote their economic potential. It is not impossible if the Garden would be repeating it's successfully working on the domestication and introduction of some new economic crops.

The genus *Hoya* (Asclepiadaceae) is one of the wild Indonesian Floras, which have high economic potential as exotic ornamental plant. It has unique star waxy beautiful flowers. Most of the species also have decorative vein on leaves, succulent, and nice arrangement. The appreciation

on this plant as ornamental is increasing particularly among the European, American and Australian. Several associations dedicated to the *Hoya* cultivation have been founded following the increase of the popularity (Hodgkiss 1997). Unfortunately, the hunting of the species by some collectors to the native habitat also increased. It becomes the threat to the existention of some species. Instead, the habitat conversion is also increased day by day. Several species become rare and toward extinction in the wild.

Indonesia was supposed as a center for *Hoya* species diversity (Kleijn and van Donkelaar 2001). The geographical distribution of the Genus start from Japan to Samoa and Fiji Islands, Some part of New Zealand, Tropical part of Australia, Madagascar, India, Indochina, and South of China. The greatest diversity is in the Malesian region (Goyder 1990). But, there is not attentive enough to these plants. Bogor Botanic Garden (BBG) as ex-situ plant conservation institution have been realized that condition. The first *Hoya* collection was registered in 1894 (*H. diversifolia* Blume and *H. bandaensis* Schltr.) and become increasing in number of species to 23 until 1950's. Unfortunately, since 1970's many of the living collection were died. Until 1994, only 5 species remain alive. Then, several activities have been done in order to conserve the Indonesian *Hoya* germplasm. It includes three main activities: (i) Inventory of Indonesian *Hoya* species, (ii) Living collection management, and (iii) Sustainable utilization.

MATERIALS AND METHODS

Inventory of the Indonesian *Hoya* species

The inventory of the Indonesian *Hoya* species was done based on the literature, herbarium sheets at Herbarium Bogoriense (BO) and living collection at BBG. Living collection of Indonesian *Hoya* obtained particularly as result from the Flora Exploration Program. The annual Flora Exploration Program has been done since 1991 and has been active collects the *Hoya* species since 1995. The program is still continued. Identification of living collection and herbarium sheets referred to Rintz (1978), Backer and Bakhuizen Jr. (1965), Hooker (1885), Merrill (1923), Schlechter (1914).

A comparative study to the herbarium collection also did at University Pertanian Malaysia Herbarium (Selangor, Malaysia) and Forest Research Institute Malaysia Herbarium (Kepong, Malaysia) in April 1996 during 2 weeks. My study was supervised by Prof. Dr. Ruth Kiew (formerly: UPM; now: Singapore Botanical Garden).

Living collection management

The various techniques are used to maintain the living collection resulted from the Flora exploration. The plant usually propagates by cuttings. Cuttings were rooted in a case filled with sterile sand as media and covered with a glass window that can easily open and closed. If the shoot appears about 5 cm long, then the plant was moved on an individual pot. The media for pot plant are Fern (*Cyathea*) stem crump, charcoal, and the root of birds nest fern (*Asplenium nidus*). The plants water daily.

Tissue culture method was also tried in order to find the best nutrition composition. This method intended for clonal propagation and rescue for the rare species.

Hoya interspecific grafting was applied to the particular species that not adaptive to the media. The adaptive species are used as rootstock.

Sustainable utilization

Hoya has been promoted as ornamental plant, instead of the traditional use as medicine. The adaptation in cultivation and propagation were studied to find the best method on cultivation, especially for intended species considered as ornamental plant.

Some mutation techniques also did in order to find new variety. The colchicine treatment was applied to *Hoya diversifolia* in 1998. Nuclear radiation at Badan Tenaga Atom Nasional (National Agency for Nuclear Power Radiation) applied to *Hoya bandaensis* in 1998. Combination treatment between lighting of the plant (light radiation) and chemical treatment to the media was applied to *Hoya diversifolia* in 1996.

Cross-pollination also did, but the techniques also need developing.

RESULT AND DISCUSSION

Inventory of the Indonesian *Hoya* species

Any difficulties were found on each determination of species on the herbarium sheets. The herbarium sheets are very different from the living plant, particularly on the succulent species. Observation on living collection showed high plasticity on leaf morphology. The observation must do several times both on the herbarium sheets and the living collection to conclude the exact identification and determination.

There are 52 *Hoya* species listed in Table 1 according to the literature, herbarium sheets (BO) and living collection (BBG). But the exact name and number of species occur in Indonesia are still uncertain. Revision of this genus doesn't do well and is still incomplete. *Hoya* species was published by several people from several part/region, so sometimes one species bears several names or different species thought to one species was happens. Inventory work on Sumatra's *Hoya* (Rahayu 2001a) indicated that the species number tend to be increased more than expected before. Another inventory work on Sabah and Sarawak was done by Pia Nutt (2001) recognized of 25 species that I thought will be mostly similar to the Kalimantan (Indonesia's Borneo). The assumption was based on the result in Sumatra's *Hoya* that mostly similar (22 of 25 are the same species) to the Malay Peninsula's *Hoya* species (Rahayu 2001a).

Several species were cited as new geographical distribution record. *H. vitellinoides* was formerly known only from Java in 1928 at 250 m above sea level (Bakh # 4181), but another living collections were found in Sumatra (Jambi, alt. 1650 m) in 1994 and 1997. *H. caudata*, *H. parviflora*, *H. erythrostemma* as Rintz (1978) mentioned as endemic to the Malay Peninsula and South Thai, also

occurs in Sumatra. Rintz (1978) also thought that *H. elliptica*, *H. scortechinii*, *H. pusilla* and *H. wrayi* are endemic to Malay Peninsula, but also found in Sumatra and Kalimantan. The species collections from the East Indonesian region are almost new to the Botanic Garden.

In 1994, the *Hoya* collection in The Bogor Botanic Garden was only 12 species: Through the Flora Exploration Program that annually does since 1991 and actively collect the *Hoya* since 1995, the number of species is increased to 32 species in 1997 (Rahayu 1999). The number of species is still increased to 45 species in 2002, including 9 unidentified species, as listed in Table 2. Most of them are new collection for The Bogor Botanic Garden.

Table 1. Alphabetical list of Indonesian *Hoya* Species

Species name		Sumatra.	Java	Kalim.	Sulaw.	Moluc.	L. Sunda	Papua
H. aeschynanthoides Schltr.	* 3					+		
H. anulata Schltr.	* 3				+	+		
H. bandaensis Schltr.	* 3					+		
H. bilobata Schltr.	* 3				+			
H. campanulata Blume	*H 2	+	+					
H. caudata Hook.f.	H	+						
H. cinnamomifolia Hook.f.	1							
H. coriacea Blume	* H 1			+				
H. coronaria Blume	*H 1	+		+				
H. densifolia Turcz.	* H 1		+					+
H. diversifolia Blume	* H 1	+	+		+			
H. elliptica Hook.f.	* H	+		+				
H. erythrostemma Kerr.	H	+						
H. finlaysonii Wight	* H	+		+				
H. flavida Forster and Liddle	4							+
H. forbesii King and Gamble	2	+						
H. gigas Schltr.	3							+
H. kuhlii Blume	* 1		+					
H. imbricata Decne	* H				+			
H. imperialis Lindl.	* H	+		+				
H. lacunosa Blume	* H 1	+	+					
H. lasiantha Korth.	* H 1	+	+	+				
H. latifolia G. Don.	* H 2	+	+	+				
H. lauterbachii Schltr.	H					+		+
H. longifolia Wall.	*			+	+			
H. litoralis Schltr.	3							+
H. macrophylla Bl.	* H 1	+		+				
H. macgregorii Schltr.	3					+		
H. meredhitii T.Green	*			+				
H. micrantha Hook.f.	* H							
H. minahasae Schltr.	5				+			
H. mitrata Kerr.	* H	+		+				
H. multiflora Blume	* H	+	+	+	+			
H. nummularioides Const.	*			+				
H. obovata Decne	*				+			
H. oblanceolata Hook.f.	*	+						
H. obtusifolia Wight	*H	+						
H. odorata Schltr.	*							+
H. parasitica Wall.	*H	+	+		+			
H. pauciflora Wight	*				+			
H. parviflora Wight	*H	+						
H. pusilla Rintz	*			+				
H. purpureo-fusca Hook.f.	* 1		+				+	
H. revoluta Wight	* H	+		+				
H. scortechinii K. & G.	*H	+						
H. sussuella Merr.	*					+		+
H. tenggerensis Bakh.f.	1		+					
H. tjadasmalangensis Bakh.f	1		+					
H. uncinata T. & B.	1		+					
H. vitellina Blume	*1		+					
H. vitellinoides Bakh.f.	*H1	+	+					
H. wrayi K. & G.	*	+						

Notes: *collected during Flora exploration 1995-2002, H = Known from herbarium sheet at BO. The number/s indicated from literature: 1. Backer & van Den Brink (1965), 2. Rintz (1978), 3. Schlehter (1913), 4. Forster and Liddle (1993), 5. Koorders (1898)

Living collection management

There are about 45 living *Hoya* species in Bogor Botanic Garden mainly resulted from flora exploration (Table 2.). All of the living collection is propagate by cutting. All of the species can easily root on the sand media. But some species don't adapt well in the clay pot media. They have weakness on the root system. The roots usually damaged by nematodes. Another pest observed in the garden is aphids, scales, and caterpillars. Several species are adapted well in the garden condition, but several ones are difficult to save. Nine species have died during their adaptation in the garden (Table 2). There are the most five difficult and easy growing species according to the observation in the Garden are listed in Table 3.

Hoya imperialis is one of the difficult growing species. After 5 months planted in clay pot, the plant will be withering and dying, because the root of this species doesn't adapt well in the media. Interspecific grafting by using *Hoya coronaria* as rootstock has made good result. *Hoya coronaria* have more adaptable root system, and closely related to *Hoya imperialis*. This plant grows well and still alive right now.

Table 2. The *Hoya* species have been collected in Bogor Botanic Gardens (1995-2002), West Java, Indonesia

Species name	Loc. /alt. (m. a. s. l.)	Flowering time in the garden
H. aeschynanthoides Schltr.	Maluku, 50	Not flower yet
H. annulata Schltr.	Maluku, 0-50	July 1999
H. bandaensis Schltr.	Maluku, 50	November, 1994
H. bilobata Schltr.	Sulawesi, 50-700	Often
H. campanulata Bl.	Sumatra., 100-700	Often
H. coriacea Bl.	Kalimantan, 200-450	Not flower yet
H. coronaria Bl.	Sumatra, Kalimantan, Sulawesi, 80-500	Not flower yet
H. densifolia Turc.	Jawa, 0-50	August 2002
H. diversifolia Bl.	Sumatra, Jawa, Sulawesi, 0-900	April-June every year
H. elliptica Wight (!)	Sumatra, Kalimantan, 200-500	Not flower yet
H. finlaysonii Wight (!)	Sumatra, Kalimantan, 100-400	Not flower yet
H. *kuhlii* Blume	Jawa, 1100	November 1997
H. imbricata Wight (!)	Sulawesi, 180	Not flower yet
H. imperialis Lindl.	Kalimantan, Sumatra, 100-200	Not flower yet
H. lacunosa Bl.	Jawa, Sumatra, 200-900	Often
H. lasiantha Korth. (!)	Kalimantan, 100-200	Not flower yet
H. *latifolia* G.Don.	Kalimantan, Sumatra, Jawa, 50-1300	Often
H. macrophylla Bl.	Kalimantan, Sumatra, 500-700	Oktober 1998
H. micrantha Hook.f.	Sumatra, 500	July 2000
H. mitrata Kerr.	Kalimantan, Sumatra, 350-500	July-November 1997
H. multiflora Bl.	Jawa, Sulawesi, 200-500	August-December 1997
H.cf. *nummularioides* Const.	Kalimantan, 300-500	Not flower yet
H.cf. *obovata* Decne	Sulawesi, 50-100	Not flower yet
H. oblanceolata Wight	Sumatra, 100	July 2000
H. obtusifolia Wight (!)	Sumatra, 500	Not flower yet
H. odorata Schltr. (!)	Papua, 1200	Not flower yet
H. parasitica Wall.	Sumatra, Jawa, Sulawesi, 100-500	Often
H. cf. pauciflora Wight	Sulawesi, 500	Oktober 1998
H. parviflora Wight (!)	Sumatra, 950-1150	Not flower yet
H. pusilla Rintz	Kalimantan, 50-300	1997-1998 all month
H. purpureo-fusca Hook.f.	Jawa, 600-1100	November 1998
H. revoluta Wight	Sumatra, Kalimantan, 500	Not flower yet
H. scortechinii K&G	Sumatra, Kalimantan, 200-500	Not flower yet
H. cf. *sussuella* Merr.	Papua, 50	Not flower yet
H. *vitellina* Blume	Jawa, 150	September-Nopember every year
H. *vitellinoides* Bakh.f. (!)	Sumatra, 1500-1700	Not flower yet
H. cf. *wrayi* King &Gamble (!)	Sumatra, 600	Not flower yet
H. sp maluku tipis	Maluku, 50	September 2002
H. sp sulut besar	Sulawesi, 150-200	Not flower yet
H. sp jabar	Jawa, 200	Not flower yet
H. sp jambi	Sumatra, 500	Not flower yet
H. sp sulteng	Sulawesi, 500	Not flower yet
H. sp lugre	Papua, 1200	Not flower yet
H. sp akar mao	Kalimantan, 200	July 1998

Notes: (!) Already died during their adaptation in the Bogor Botanic Gardens

Table 3. The most five difficult and easy growing species

Hoya species
Easy growing species
H. diversifolia
H parasitica
H. latifolia
H. lacunose
H. bandaensis
Difficult growing species
H. imbricata
H. lasiantha
H. finlaysonii
H. elliptica
H. imperialis

Sustainable utilization

Several activities on observation/characterization on the morphology of *Hoya* species have been done (Rahayu, 2001b). Most of *Hoya* species was recommended as pot plant, besides *H. diversifolia* was also recommended as cut flower. The promotion as cut flower would bee need more research and experiments on horticultural aspects. The experimental research in *Hoya* hydroponics is still in progress.

The results from the experimental mutations do not always good. Colchicine treatment on *H. diversifolia* and Gamma ray radiation to *H. bandaensis* are not satisfying yet. These plants don't flowering yet. The good result was obtained from another treatment. A new variety from *H. diversifolia* was obtained from the combination of chemical treatment on the media and plant lighting. The treatment was started in 1996 and the first flower from the mutant plant was appearing in 2001. The new variety has similarities with the original species in the morphological but different in flower color. The original species have pink color in corolla and corona, but the new one is creamy white. A slight color difference also occurs on the young leaves and shoots. Sometimes, the color of the original species has a slight purple on the green color, but the new variety has a plain green color. Registration for plant variety protection is not realized yet, because the rules are still in discussion by the commission.

Epilogue

These activities are still continued involving a line research on the biology and cultivation of this genus. The inventory of the species is also continued. We are still waiting for a complete taxonomical revision. The living collection is hopefully increased in number of species through annually exploration program. Several programs in cultivation would be the priority instead improvement on determination and identification of living and herbarium collection.

The promotion program as ornamental should be accompanied with plant sale and publication program. Unfortunately, at the moment we still develop the clonal propagation techniques as a tool for providing "sold plant" stock. We hope it will be realized soon. And, to increase the awareness of the people appreciation on this plant, we are going to propose to the establishment of a *Hoya* Garden.

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