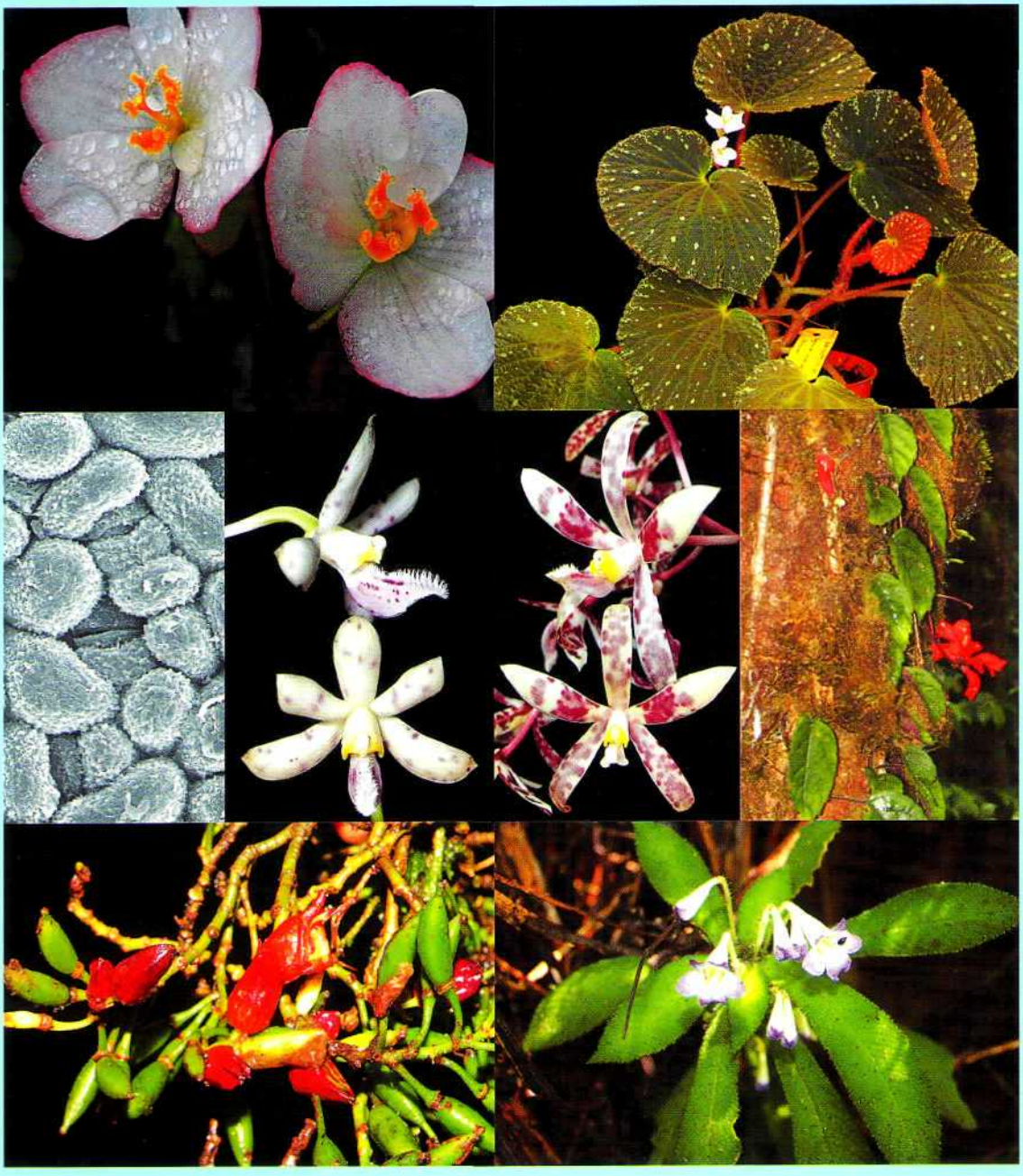
LIPI

REINWARDTIA

A JOURNAL ON TAXONOMIC BOTANY, PLANT SOCIOLOGY AND ECOLOGY

ISSN 0034 – 365 X



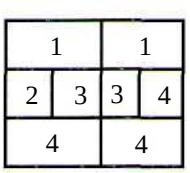
2014 14 (1)

REINWARDTIA

A JOURNAL ON TAXONOMIC BOTANY, PLANT SOCIOLOGY AND ECOLOGY

Vol. 14(1): 1-248, December 23, 2014

Correspondence on editorial matters and subscriptions for Reinwardtia should be addressed to:
HERBARIUM BOGORIENSE, BOTANY DIVISION,
RESEARCH CENTER FOR BIOLOGY- INDONESIAN INSTITUTE OF SCIENCES
CIBINONG SCIENCE CENTER, JLN. RAYA JAKARTA - BOGOR KM 46,
CIBINONG 16911, P.O. Box 25 Cibinong
INDONESIA
PHONE (+62) 21 8765066; Fax (+62) 21 8765062
E-MAIL: reinwardtia@mail.lipi.go.id



Cover images: 1. *Begonia holosericeoides* (female flower and habit) (Begoniaceae; Ardi *et al.); 2.* Abaxial cuticles of *Alseodaphne rhododendropsis* (Lauraceae; Nishida & van der Werff); *3. Dipodium puspitae, Dipodium purpureum* (Orchidaceae; O'Byrne); 4. *Agalmyla exannulata, Cyrtandra coccinea* var. *celebica, Codonoboea kjellbergii* (Gesneriaceae; Kartonegoro & Potter).

The Editors would like to thanks all reviewers of volume 14(1):

Abdulrokhman Kartonegoro - Herbarium Bogoriense, Bogor, Indonesia
Altafhusain B. Nadaf - University of Pune, Pune, India
Amy Y. Rossman - Systematic Mycology & Microbiology Laboratory USDA-ARS, Beltsville, USA
Andre Schuiteman - Royal Botanic Gardens, Kew, UK
Ary P. Keim - Herbarium Bogoriense, Bogor, Indonesia
Barry Conn - Royal Botanic Gardens National Herbarium of New South Wales, Sydney, Australia
Dato' Abdul Latiff Mohamad - Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia
Daniel Potter - Department of Plant Sciences, University of California, Davis, California, USA
Deby Arifiani - Herbarium Bogoriense, Bogor, Indonesia
Ferry J. W. Slik - University of Brunei Darussalam, Brunei
Henti H. Rachmat - Conservation and Rehabilitation Research and Development Center, Bogor, Indonesia
Ian M. Turner - Royal Botanic Gardens, Kew, UK
Iskandar Z. Siregar - Bogor Agricultural University, Bogor, Indonesia
Jay H. Bernstein - Kingsborough Community College, Brooklyn, New York, USA
Jens G. Rohwer - University of Hamburg, Hamburg, Germany
Joan Pereira - SAN Herbarium, Sabah Forestry Department, Sabah, Malaysia
Kuswata Kartawinata - Herbarium Bogoriense, Bogor, Indonesia
Lars H. Schmidt - University of Copenhagen, Copenhagen, Denmark
Mark Hughes - Royal Botanic Gardens, Edinburgh, UK
Masahiro Kato - Kyoto University, Kyoto, Japan
Nuril Hidayati - Herbarium Bogoriense, Bogor, Indonesia
Ong Poh Teck - Forest Research Institute Malaysia, Kepong, Malaysia
Peter C. van Welzen - National Herbarium Netherlands, Leiden University Branch, Leiden, Netherlands
Reuben Nilus - Sabah Forestry Department, Sabah, Malaysia
Rugayah - Herbarium Bogoriense, Bogor, Indonesia
Ruth Kiew - Forest Research Institute of Malaysia, Kepong, Malaysia
Uwe Braun - Institut für Biologie Bereich Geobotanik und Botanischer Garten, Halle (Saale), Germany
Yasuaki Sato - Osaka-Sangyo University, Osaka, Japan

REINWARDTIA
Vol 14, No 1, pp: 79 − 83

TRICHOMES MORPHOLOGY ON PETALS OF SOME ACANTHACEAE SPECIES

Received November 28, 2013; accepted June 5, 2014

MUHAMMAD AMIRUL AIMAN AHMAD JUHARI
School of Environmental and Natural Resource Sciences, Faculty of Science and Technology Universiti Kebangsaan Malaysia.43600 Bangi, Selangor. E-mail: amirulaimanahmad@gmail.com

NORAINI TALIP
School of Environmental and Natural Resource Sciences, Faculty of Science and Technology. Universiti Kebangsaan Malaysia.43600 Bangi, Selangor. E-mail: ntalip@ukm.edu.my

CHE NURUL AINI CHE AMRI
School of Environmental and Natural Resource Sciences, Faculty of Science and Technology. Universiti Kebangsaan Malaysia.43600 Bangi, Selangor.

MOHAMAD RUZI ABDUL RAHMAN
School of Environmental and Natural Resource Sciences, Faculty of Science and Technology. Universiti Kebangsaan Malaysia.43600 Bangi, Selangor.

ABSTRACT
JUHARI, M. A. A. A., NORAINI. T., AMRI, C. N. A. C. & RAHMAN, M. R. A. 2014. Trichomes morphology in petals of some Acanthaceae species. *Reinwardtia* 14(1): 79 – 83. — A preliminary taxonomic study was carried out on seven Acanthaceae species namely as *Andrographis paniculata, Pseuderanthemum graciliflorum, P. carruthersii, Asystasia gangetica* ssp. *micrantha, Ruellia repens, Justicia comata* and *J. betonica*. The study was undertaken to investigate the morphology of trichomes present on the surfaces of flower petal. The variations found in this study are in their types and density. Based on observation, two forms of trichomes are present in all species studies which are glandular and non-glandular trichomes. There are seven types of trichomes found in this study. Trichomes types are shown to have systematic significance that can be used to differentiate and identify certain Acanthaceae species studied.

Key words: Acanthaceae, floral anatomy, trichomes.

ABSTRACT
JUHARI, M. A. A. A., NORAINI. T., AMRI, C. N. A. C. & RAHMAN, M. R. A. 2014. Morfologi trikom daun mahkota beberapa jenis Acanthaceae. *Reinwardtia* 14(1): 79 – 83. — Studi pendahuluan taksonomi dilakukan pada beberapa jenis Acanthaceae yaitu *Andrographis paniculata, Pseuderanthemum graciliflorum, P. carruthersii, Asystasia gangetica* ssp *micrantha, Ruellia repens, Justicia comata* dan *J. betonica*. Studi ini dilakukan untuk mengetahui morfologi trikom yang terdapat pada permukaan daun mahkota bunga. Dalam studi ini ditemukan variasi pada tipe dan kepadatannya. Berdasarkan hasil pengamatan semua jenis diketahui terdapat dua bentuk trikom yaitu berbentuk kelenjar dan tidak berkelenjar. Terdapat tujuh macam trickom pada pengamatan ini. Tipe trikom secara sistematika menunjukkan karakter diagnostik untuk membedakan serta mengidentifikasi beberapa jenis Acanthaceae pada studi ini.

Kata kunci: Acanthaceae, anatomi bunga, trikom.

INTRODUCTION

Acanthaceae is a plant family under the order Lamiales with at least of 4000 tropical and subtropical species (Borg, 2008). There are three subfamilies in Acanthaceae which are Acanthoideae, Thunbergioideae and also Nelsonioideae (Borg &Schonenberger, 2011). Acanthaceae is known as third largest tropical plant family after Myrtaceae and Melastomataceae (Grant, 1955). According to McDade *et al.* (2008), even though Acanthaceae is an important plant family in the tropical and subtropical countries of the world, the information about the phylogenetic of this plant family is very little and thus prevent from comparative study being conducted. Not only known as horticulture plant, this family also have an economic value and useful for medicinal purposes (Grant, 1955).

Trichomes are defined as unicellular or multicellular appendages, which originates from the epidermal cells and develop outwards on the surface of various plant organs and often covered the aerial organs or plants, and the morphology of trichomes structures vary greatly between species (Werker, 2000). Cutler *et al.* (2008) stated that, trichomes are hairs, papillae and scales that exhibit the same wide

range as on the leaf and the type of hair can be of diagnostic value at species level, sometimes also at genus level, but rarely at family level. According to Navarro & El Oualidi (2000), trichomes also known as hairs or glandular hairs commonly found on the epidermis of plants. It is among the most useful taxonomic characters. On the other hand, they serve as physical and chemical block against biotic and abiotic stresses (Kim *et al*., 2012). Rao & Ramayana (1977) stated that, the trichomes types are not only serve in the identification of species but also their corresponding part thus being important in pharmacognosy, archaeobotany, paleobotany and agronomy.

The morphological and mechanical features (density, size, shape, surface texture, hair orientation) of trichomes can influence many aspects of plant physiology and ecology, such as to reduce insects movements, mechanical abrasion, and leaf wetness, for temperature regulation, increase light reflectance (including UV), decrease water loss through reflection, protection of phylloplane organisms, pollinator attraction, allelopathy and many more (Wagner *et al*., 2004). Therefore this study was conducted to investigate the detail morphology of trichomes of all species studied and to investigate its systematic significance in the family Acanthaceae.

MATERIAL AND METHODS

Seven Acanthaceae species were chosen namely as *Andrographis paniculata* Nees*, Pseuderanthemum graciliflorum* Ridl.*, P. carruthersii* (Seem) Guillaumin*, Asystasia gangetica* ssp. *micrantha* (L.) T. Anderson*, Ruellia repens* (Nees) Angely*, Justicia comata* (L) Lam. and *J. betonica* T. Anderson. All species studied belong to the subfamily Acanthoideae. The fresh flower materials were collected from several locations in Peninsular Malaysia such as Tasik Chini, Felda Chini, Felda Chemomoi, Pahang, and Hutan Lipur Sungai Kanching, Selangor. Fresh flower specimens were fixed in AA (70% Ethanol: 30% Acetic Acid in a ratio of 1:3). A measurement of 1 cm × 1 cm flower petal was cleared using Basic fuchsion solution (10% Basic fuchsion and 10% KOH), and placed in the microwave at about 60^0C for several hours. This was done to ensure that the epidermis layers of the samples were completely removed. Cleared petal specimens were mounted on the glass slides using Canada balsam and kept in the oven at 60^0C for about two weeks. Photograph of cleared petals was taken using video camera DP 25 Olympus attached to an Olympus microscope and images were processed using Cell^B Software and Adobe Photoshop. The preparations of the slides followed method by Johansen (1940) and Sass (1958) with suitable modifications.

RESULTS

The findings of this study have shown that eleven types of trichomes were found including eight non-glandular and three glandular trichomes listed as follows (Singh & Jain, 1975):

I. Non-glandular unicellular- Conical filiform unicellular trichome (A (i))
II. Non-glandular unicellular - Papilose unicellular trichomes (D (i))
III. Non-glandular uniseriate filiform-Bicelled trichomes(C(i))
IV. Non-glandular uniseriate filiform- Simple filiform trichomes (E)
V. Non-glandular uniseriate filiform- Clavate filiform trichomes (C(ii))
VI. Non-glandular uniseriate filiform - Conical filiform trichomes (F(ii))
VII. Non-glandular uniseriate filiform- Cylindrical filiform trichomes (B)
VIII. Non-glandular uniseriate filiform Pedestallated filiform trichomes (G(ii))
IX. Peltate glandular -With multi-celled head, 1-3 elongated stalk cells and a small neck cell (A (ii))
X. Peltate glandular -Multicellular head (F(i))
XI. Vesicular glandular - With unicellular head and 1-2-cells stalk (G(i))

The summary of trichomes types on petal of all species studied is shown in Table 1. Non-glandular types of trichomes are found on the surfaces of the petal in all of the species studied. The glandular trichomes present in three species studied which are peltate glandular - with multi-celled head, 1-3 elongated stalk cells and a small neck cell in *Andrographis paniculata,* Peltate glandular - multicellular head in *Justicia comata* and vesicular glandular - with unicellular head and 1-2-celled stalk in *Justicia betonica*, but absent in other four species.

Two types of non-glandular trichomes were found on the species of *Asystasia gangetica* ssp. *micrantha* in this study which are non-glandular uniseriate filiform - bicelled trichomes and non-glandular uniseriate filiform - clavate filiform trichomes, whereas other species only consist of one type of non-glandular trichomes.

DISCUSSION

According to Hardin (1979), the morphological characteristics of trichomes have played an impor-

tant role in plant systematics, especially of particular group at generic and specific levels. Previous study has suggested that the presence or absence of peltate hairs and their forms, size and colour could be used in distinguishing between genera and species of plants (Spring, 2000). Hairs or trichomes may serve to protect buds of some plants until defense phytochemicals are produced (Johnson, 1975). Dead trichomes may continue to function in water absorption, seed dispersal and abrasion protection (Werker, 2000).

From result obtained, all of the species studied consists of non-glandular trichomes on its petal (Fig. 1; Table 1). Except for *Asystasia gangetica* ssp. *micrantha*, all of other species studied having only one type of non-glandular trichomes. According to Metcalfe (1960) non-glandular trichomes are called prinkle hairs and have smooth cell wall surfaces. Non-glandular unicellular trichomes can only be found in *Andrographis paniculata* and *Pseuderanthemum carruthersii*, while the other species consists of non-glandular uniseriate filiform trichomes. In the species with glandular trichomes, only *Justicia betonica* are having glandular vesicular trichomes, whereas, *Andrographis paniculata* and *Justicia comata* are having glandular peltate trichomes. *Andrographis paniculata, Justicia comata*, and *Justicia betonica* are the only species that having non-glandular and glandular trichomes on the surfaces of the petals. Therefore, the type of trichomes presence can be used as the diagnostic characteristics for species differentiation of these seven species. Ascensão *et al.* (1996) stated that, the great diversity of plant trichomes has attract botanists interest by their adaptive and taxonomic value and in some family, this can be used as discriminative characters at subfamiliar level.

Both of non-glandular and glandular trichomes were found in this study. Non-glandular and glandular trichomes are classified according to their morphology. On the petal, the non-glandular trichomes are unicellular and multicellular with one to three cells and also pointed-shaped. Some of the non-glandular trichomes consist of echinate ornamentation on its surfaces. They may be unicellular or multicellular, and both types can be unbranched and branched (Amalia *et al.,* 2013). Simple trichomes can forms at various stages of organ development, and same senescence before the organ reaches maturity, while others remain until plant senescence (Wagner *et al.,* 2003).

There are two type of glandular trichomes found, which are the peltate and vesicular glandular trichomes. Werker (1993) stated that glandular trichomes produced essential oils in order to protect the aerial parts of the plants against herbivores and pathogens. Peltate trichomes also have different secretion processes. The secretory product in peltate trichomes remain trapped in a large subcuticular cavity, and the cuticular will only rupture if there are external factors such as high temperatures, low air humidity or animal aggression (Ascensão *et al*., 1996).

As a conclusion, findings in this study have shown and proven that the presence and types of trichomes have systematic significance in all seven species studied.

ACKNOWLEDGEMENTS

We wish to thank Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM) for providing us with many facilities to conduct this study.

REFERENCES

AMALIA, R., NORAINI, T., JALIFAH, L., RUZI, A. R. & IDRIS, S. 2013. Morphology of trichomes in *Pogostemon cablin* Benth. (Lamiaceae). *Australian Journal of Crop Science* 7(6): 744–749.

ASCENSÂO, L., MARQUES, N. & PAIS, M. S. 1996. Glandular trichomes on vegetative and reproductive organs of *Leonotis leonurus* (Lamiaceae). *Annals of Botany* 75: 619–626.

BORG, A. J. 2008. Phylogenetics and floral structure in Thunbergioideae and *Avicennia* (Acanthaceae). Licentiate Thesis in Systematic Botany. Department of Botany. Stockholm University (Unpublished Research Article).

BORG, A. J. & SCHONENBERGER, J. 2011. Comparative floral development and structure of the black mangrove genus *Avicennia* L. and related taxa in the Acanthaceae. *International Journal of Plant Sciences* 172: 330–344.

CUTLER, D. F., BOTHA, T. & STEVENSON, D. W. 2008. Plant anatomy: an applied approach. Blackwell Publishing. United Kingdom.

GRANT, W. F. 1955. A cytogenetic study in the Acanthaceae. *Brittonia* 8(2): 121–149.

HARDIN, J. W. 1979. Atlas of foliar surface features in woody plants, I. Vesture and trichome types of eastern North America. *Quercus Bulletin Torrey Botany. Club* 106: 313-325.

JOHANSEN, D. A. 1940. *Plant Microtechnique.* New York: McGraw-Hill Book Company Inc. P. 97.

JOHNSON, H. B. 1975. Plant pubescence: an ecological perspective. *Botanical Review* 41: 233–253.

KIM, H. J., SEO, E.Y., KIM, J. H., CHEONG, H. J., KANG, B. C., & CHOI, D. I. 2012. Morphological classification of trichomes associated with possible biotic stress resistance in the genus *Capsicum*. *The Plant Pathology Journal* 28(1): 107–113.

MCDADE, L. A., DANIEL, T. F. & KIEL, C. A. 2008. Toward a comprehensive understanding of phylogenetic relationships among lineages of Acanthaceae s. l. (Lamiales). *American Journal of Botany* 95(9):

1136–1152.
METCALFE, C. R. 1960. *Anatomy of the monocotyledons*: I. Graminae. Clarendon Press, Oxford. UK.
NAVARRO, T. & EL OUALIDI, J. 2000. Trichome morphology in *Teucrim* L. (Labiatae). A taxonomic review. *Anales Jardin Botanico De Madrid* 57(2): 277–297.
RAO, S. R. S. & RAMAYANA, N. 1977. Structure distribution and taxonomic importance of trichomes in the Indian species of *Malvastrum*. *Phytomorphology*. 27: 40–44.
SASS, J. E. 1958. Botanical Microtechnique. 3rd. ed. Pp. 78. Lowa: State University Press.
SINGH, V. & JAIN, D. K. 1975. Trichomes in Acanthaceae. I. General structure. *Journal of Indian Botanical Society*. 54: 116–127.
SPRING, O. 2000. Chemotaxonomy based on metabolites from glandular trichomes. *Advances in Botanical Research* 31: 153–174.
WAGNER, G. J., WANG, E. & SHEPHERD, R. W. 2004. New approaches for studying and exploiting an old protuberance, the plant trichome. *Annals of Botany* 93: 3–11.
WERKER, E. 1993. Function of essential oil secreting glandular hairs in aromatic plants of Lamiaceae-a review. *Flavour and Fragrance Journal* 8: 249–255.
WERKER, E. 2000. Trichome diversity and development. In: HALLAHAN D. L. & GRAY J. S. (Eds.), *Advances in Botanical Research*. 31: 1–35.

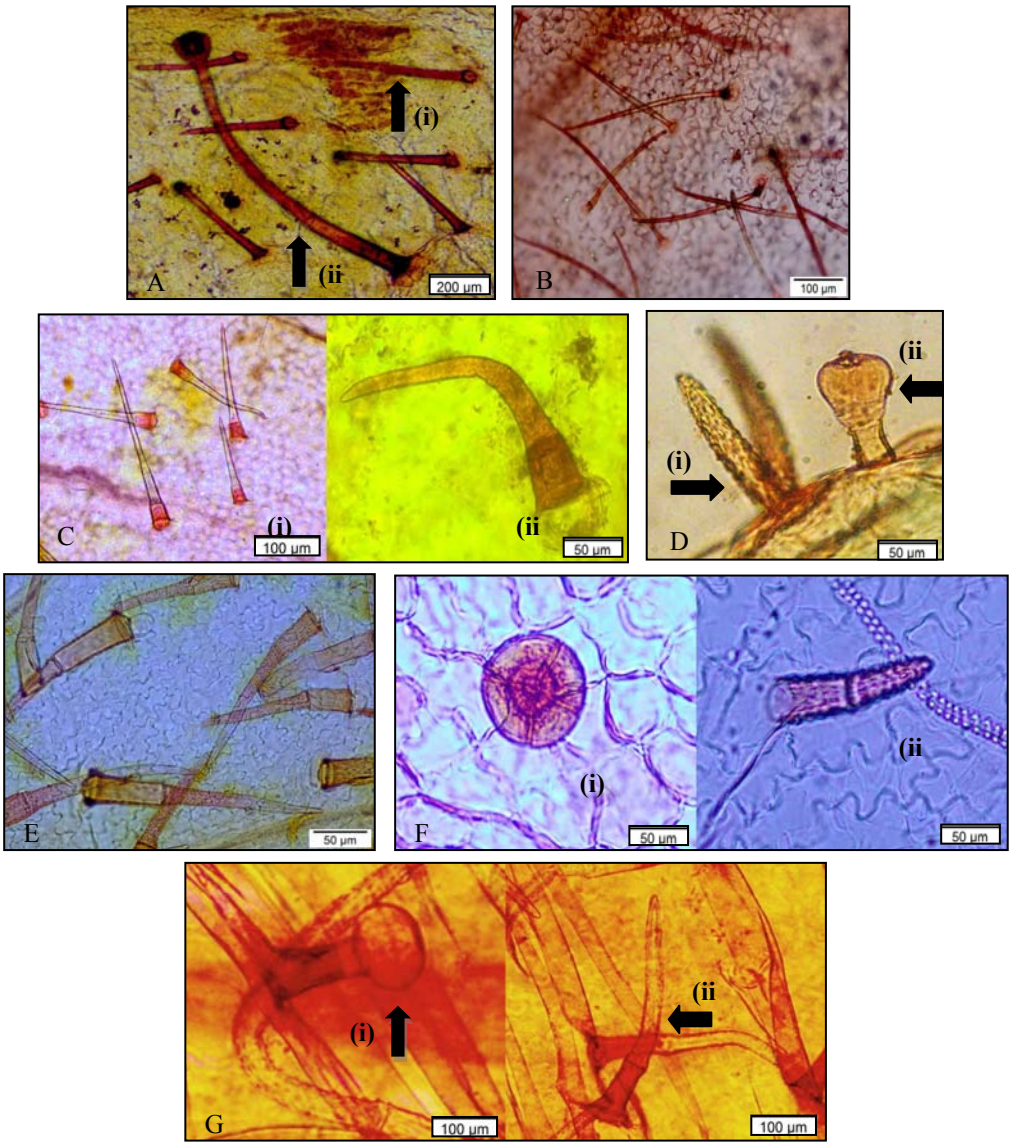


Fig. 1. Trichomes on petal of A. *Andrographis paniculata*. B. *Pseuderanthemum graciliflorum*. C. *Asystasia gangetica* ssp. *micrantha*. D. *Pseuderanthemum carruthersii*. E. *Ruellia repens*. F. *Justicia comata*. G. *Justicia betonica.*

Table 1. List of species studied and types of trichomes found in this study.

Species	Non Glandular							Glandular		
								Peltate		Vesicular
	Conical filiform	Papilose	Bicelled	Simple filiform	Clavate filiform	Conical filiform	Pedestellated filiform	With multicelled head, 1-3 elongated stalk cells & a small neck cell	Multicellular head	With unicellular head & 1-2-celled stalk
Andrographis paniculata	+	-	-	-	-	-	-	+	-	-
Pseuderanthemum graciliflorum	-	-	-	-	-	-	+	-	-	-
Asystasia gangetica ssp. *micrantha*	-	-	+	-	+	-	-	-	-	-
Pseuderanthemum carruthersii	-	+	-	-	-	-	-	-	-	-
Ruellia repens	-	-	-	+	-	-	-	-	-	-
Justica comate	-	-	-	-	-	+	-	-	+	-
Justica betonica	-	-	-	-	-	-	-	-	-	+

INSTRUCTION TO AUTHORS

Scope. *Reinwardtia* is a scientific irregular journal on plant taxonomy, plant ecology and ethnobotany published in December. Manuscript intended for a publication should be written in English.

Titles. Titles should be brief, informative and followed by author's name and mailing address in one-paragraphed.

Abstract. English abstract followed by Indonesian abstract of not more than 250 words. Keywords should be given below each abstract.

Manuscript. Manuscript is original paper and represent an article which has not been published in any other journal or proceedings. The manuscript of no more than 200 pages by using Times New Roman 11, MS Word for Windows of A4 with double spacing, submitted to the editor through <reinwardtia@mail.lipi.go.id>. New paragraph should be indented in by 5 characters. For the style of presentation, authors should follow the latest issue of Reinwardtia very closely. Author(s) should send the preferred running title of the article submitted. Every manuscript will be sent to two blind reviewers.

Identification key. Taxonomic identification key should be prepared using the aligned couplet type.

Nomenclature. Strict adherence to the International Code of Botanical Nomenclature is observed, so that taxonomic and nomenclatural novelties should be clearly shown. English description for new taxon proposed should be provided and the herbaria where the type specimens area deposited should be presented. Name of taxon in taxonomic treatment should be presented in the long form that is name of taxon, author's name, year of publication, abbreviated journal or book title, volume, number and page.

Map/line drawing illustration/photograph. Map, line drawing illustration, or photograph preferably should be prepared in landscape presentation to occupy two columns. Illustration must be submitted as original art accompanying, but separated from the manuscript. The illustration should be saved in JPG or GIF format at least 350 pixels. Legends or illustration must be submitted separately at the end of the manuscript.

References. Bibliography, list of literature cited or references follow the Harvard system as the following examples.

Journal : KRAENZLIN, F. 1913. *Cyrtandraceae* novae Philippinenses I. *Philipp. J. Sci.* 8: 163-179.
MAYER, V., MOLLER, ML, PERRET, M. & WEBER, A. 2003. Phylogenetic position and generic differentiation of *Epithemateae (Gesneriaceae)* inferred from plastid DNA sequence data. *American J. Bot.* 90: 321-329.

Proceedings :TEMU, S. T. 1995. Peranan tumbuhan dan ternak dalam upacara adat "Djoka Dju" pada suku Lio, Ende, Flores, Nusa Tenggara Timur. In: NASUTION, E. (Ed.). Presiding Seminar dan Lokakarya Nasional Etnobotani II. LIP1 & Perpustakaan Nasional: 263-268. (In Indonesian).
SIMBOLON, H. & MIRMANTO, E. 2000. Checklist of plant species in the peat swamp forests of Central Kalimantan, Indonesia. In: IWAKUMA *et al.* (Eds.) Proceedings of the International Symposium on: Tropical Peatlands. Pp. 179-190.

Book : RIDLEY, H. N. 1923. *Flora of the Malay Peninsula 2.* L. Reeve & Co. Ltd, London.

Part of Book : BENTHAM, G. 1876. *Gesneriaceae.* In: BENTHAM, G. & HOOKER, J. D. *Genera plantarum 2.* Lovell Reeve & Co., London. Pp. 990-1025.

Thesis : BAIRD, L. 2002. *A Grammar of Kéo: An Austronesian language of East Nusantara.* Australian National University, Canberra. [PhD. Thesis].

Website : http://www.nationaalherbarium.n1/fmcollectors/k/Kostermans AJGH.htm). Accessed 15 February 2012.

Reinwardtia
Published by Herbarium Bogoriense, Botany Division, Research Center for Biology, Indonesian Institute of Sciences
Address: Jin. Raya Jakarta-Bogor Km. 46 Cibinong 16911, P.O. Box 25 Cibinong
Telp. (+ 62) 21 8765066; Fax (+62) 21 8765062
E-mail: reinwardtia@mail.lipi.go.id

REINWARDTIA Author Agreement Form

Title of article :

Name of Author(s) :

I/We hereby declare that:

- My/Our manuscript was based on my/our original work.
- It was not published or submitted to other journal for publication.
- I/we agree to publish my/our manuscript and the copyright of this article is owned by Reinwardtia.
- We have obtained written permission from copyright owners for any excerpts from copyrighted works that are included and have credited the sources in our article.

Author signature (s) Date

Name

REINWARDTIA
Vol. 14. No. 1.2014
CONTENTS
Page

Reinwardtia is a LIPI accredited Journal (517/AU2/P2MI-LIPI/04/2013)

Herbarium Bogoriense
Botany Division
Research Center for Biology - Indonesian Institute of Sciences
Cibinong Science Center
Jln. Raya Jakarta - Bogor, Km 46
Cibinong 16911, P.O. Box 25 Cibinong
Indonesia