THESIS APPROVAL

GRADUATE SCHOOL, KASETSART UNIVERSITY

Doctor of Philosophy (Botany)

DEGREE

Botany	Botany
FIELD	**DEPARTMENT**

TITLE: Taxonomic Revision of the Subtribe Barleriinae and Andrographinae (Acanthaceae) in Thailand

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THESIS

TAXONOMIC REVISION OF THE SUBTRIBE BARLERIINAE AND ANDROGRAPHINAE (ACANTHACEAE) IN THAILAND

WINAI SOMPRASONG

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Philosophy (Botany)
Graduate School, Kasesart University
2014

Winai Somprasong 2014: Taxonomic Revision of the Subtribe Barleriinae and Andrographinae (Acanthaceae) in Thailand. Doctor of Philosophy (Botany), Major Field: Botany, Department of Botany. Thesis Advisors: Associate Professor Srunya Vajrodaya, Dr.rer.nat. 147 pages.

Taxonomic revision of the subtribe Barleriinae and Andrographinae was carried out during October 2005 to July 2014. The literature and herbarium study were studied through a diagnostic herbarium specimens in various Thai and foreign herbaria in accordance with field surveys and specimen collection all over the country. The enumeration of thirty-eight species in the subtribe Barleriinae and Andrographinae (Acanthaceae) was recognized. A key to subtribes, genera and species of them was constructed in terms of identifying and description. The subtribe Barleriinae comprises of 3 genera, 15 species and subtribe Andrographinae comprises of 4 genera, 23 species. The result showed species have type locality in Thailand, subtribe Andrographinae, *viz Graphandra procumbens* Imlay, *Gymnostachyum coriaceum* Imlay, *G. gracile* Bremek., *G. signatum* (Benoist) Imlay, *G. trilobum* Ridl., *Phlogacanthus abbriviatus* (Craib) R. Ben., *P. murtonii* Craib, *P. pauciflorus* J.B. Imlay, *P. pedunculatus* J.B. Imlay, *P. racemosus* Brem., *P. rectiflorus* J.B. Imlay; subtribe Andrographinae, *viz Barleria biloba* Imlay, *B. siamensis* Craib, *Chroethes bracteata* (J.B. Imlay), *Lepidagathis chiengmaiensis* Bremek. and *L. dissimilis* Imlay.

Morphological features of seeds among the subtribe Barleriinae and Andrographinae (Acanthaceae) have been described as ovoid and strongly compressed or compressed. The features of testa were recognized in various characters such as rugulose-tubercle, rugulose, finely tuberculate, finely scaled coarsely scaled, sub-orbicular. The features of seed shape vary in different group, such as ovoid, ellipsoidal, suborbicular.

The pollen shape types of two subtribes had been divided into five distinct types, *viz* type-I (prolate spheroidal), type-II (oblate spheroidal), type-III (oblate), type-IV, type-V (suboblate). The pollen ornamentation showed seven types as type-I (reticulate tectum), type-II (open reticulate tectum), type-III (reticulate with granulate in lumina), type-IV (finely reticulate tectum with granulate in lumina): type-V (reticulate tectum with distinct aperture margin), type-VI (open reticulate tectum, granulate in lumina), type-VII (finely Reticulate tectum with distinct aperture margin).

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Student's signature Thesis Advisor's signature

ACKNOWLEDGEMENTS

I would like to express my thanks to my advisor, Associate Professor Dr. Srunya Vajrodaya, and to Dr. Kongkanda Chayamarit, co-advisor, former director of the Forest Herbarium, Department of Natonal Parks, Wildlife and Plants, Thailand for the encouragement and assistance. I would like to be grateful to Assistant Prof. Netnapis Khewkhom, chairman and Dr.Voradol Chamchumroon, representative from Graduate School, for their kind sugesstions.

I am exceedingly indebted to my excellent boss, Dr. Jaruwan Chartisathien, Director of Plant Variety Protection Office, Department of Agriculture, in many ways for her kind suggestion and supporting everything to complete this study.

I am also greatful to my both former chiefs Mrs.Vacharee Prachasaisoradej and Mrs.Tippan Sadakorn, for their encouraging.

My special thanks come to my colleagues, namely, Mr. Jessada Tengrang, teacher of Pathumwan Demonstration School, Mr. Phattaravee Phrommanat, botanist of Bangkok Herbarium, Department of Agriculture and Ms. Nongnoot Anuraktrakoon, botanist of the Rama IX Royal Botanic Garden Foundation, for their kind help drawing botanical illustrations.

Special thanks come to my beloved younger brothers, Mr. Nopparut Toonmal, Department for Development Thai Traditional and Alternative Medicine, Acting Sub Lt. Chainat Chumngoen and Mr. Samak Rattanathip, Office of Plant Variety Protection, Department of Agriculture, for their willing help in field works and available document preparation without any hesitation and to my nice younger sisters, Ms.Yuppadi Paopan, Mrs. Patcharee Umrung, Ms.Piyanan Thanomchat and Ms.Arucha Satsi, from Microscopy Units, Kasetsart University Research and Development Institute, for their help preparing plant structure in TEM and SEM laboratory.

I would like to thank my colleagues, such as Dr. Pramote Triboun and Miss Panarat Thongphoem, for their providing some necessary botanical documents and specimen information from UK.

This research was supported by Agricultural Research and Development Agency (Public Organization) (ARDA), Thailand.

Furthermore, this work is dedicated to the famous botanist who were interested in Thai Acanthus family, namely, Asst. Dr. Chirayupin Chantaraprasong, board of the Rama IX Royal Botanic Garden Foundation, Thailand; Dr. B. Hansen, late professor of University of Copenhagen, Denmark, Dr. J.B.Imlay, former Ph.D.'s student of University of Aberdeen, UK., Dr. H. Terao, former Ph.D.'s student of Kyoto University.

Winai Somprasong
July, 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

TAXONOMIC REVISION OF THE SUBTRIBE BARLERIINAE AND ANDROGRAPHINAE (ACANTHCAEAE) IN THAILAND

INTRODUCTION

The Family Acanthaceae is a large pantropical family of about 229 genera and 3,450 species in the world (Mabberley, 1997). Most of them are herbs or shrubs, including twining forms, some are spiny. The four main centres of distribution are Indo-Malaya, Africa, Brazil and Central America but a few are in the temperate zone. (Heywood, 1978). The representatives of the family can be found in nearly every habitat e.g. in dense or open forest, in thickets, on wet fields and valleys, at the sea coast and in marine areas, swamps and as an element in swamp forests (Pandry, 2005). There were about 40 genera and over 230 species in Thailand and the majority are confined all over the country (Hansen, 1985). Acanthaceae was included 221 genera treated by Scotland & Vollesen (2000), classify it into three subfamilies i.e. Nelsonioideae, Thunbergioideae and Acanthoideae. The last one is the largest subfamily which composes of two tribes i.e. Acantheae and Ruellieae. The latter tribe, comprising four subtribes and the selected two of them, subtribe Barleriinae and Andrographinae, are interesting to be revised for this research due to their well-known as theThai medicinal plants used by traditional herbalist. Some well-known species in tropical zone are *Andrographis paniculata* Nees and *Barleria lupulina* Lindl.

Notably, as a result of the largely tropical distribution of Acanthaceae, species-level diversity remains poorly understood, and there is little doubt that many new species remain to be discovered. In particular, the Neotropics house the richest and most poorly documented angiosperm flora on Earth. It is thus, not surprising that Neotropical Acanthaceae remains incompletely known and it is to be expected many more species to be described from this region.

OBJECTIVES

1. To clarify the taxonomic revision of the subtribe Barleriinae, tribe Ruellieae family Acanthaceae, sensu Scotland and Vollesen (2000)

2. To study the morphological characters of the subtribe Barleriinae and Andrographinae, family Acanthaceae

3. To enumerate the number of species and construct the keys to subtribe, genera and species

4. To conduct the comparative study of the leaf anatomy and pollen morphology of some species

5. To record the geographical distribution, ecological and phonological information, and uses of some species

LITERATURE REVIEW

1. An Introduction to Acanthaceae

The family Acanthaceae was first established by Lindau (1895) in Die Natuerlichen Pflanzenfamilien vol. 4 (3b). The type genus is *Acanthus*. There are about 229 genera and 3,450 species (Mabberley, 1997). Hansen (1985) reported that there were 40 genera, 230 species in Thailand. In the previous studies, they were classified through the morphological characters by the famous following plant taxonomists.

Benoist (1935) classified the family Acanthaceae into 6 tribes, *viz* Thunbergiees, Nelsoniees Ruelliees, Barleriees, Acanthees and Justicees.

Bremekamp (1961) classified the family Acanthaceae into 5 tribes, *viz* Acantheae, Ruellieae, Lepidagathideae, Androgrphideae and Justicieae.

Hansen (1985) classified the family Acanthaceae into 4 subfamilies, *viz* Thunbergioideae, Nelsonioideae, Acanthoideae and Ruellioideae. The subfamily Ruellioideae was classified into 4 tribes, *viz* Ruellieae, Lepidagathideae, Andrographideae and Justicieae.

At present, the studies on the family Acanthaceae are carried out through the details of corolla aestivation, palynological and phylogenetical data to serve the classification of this family. Scotland and Vollesen (2000) classified the family Acanthaceae into 3 subfamilies, *viz* Nelsonoideae, Thunbergioideae and Acanthoideae. The subfamily Acanthoideae was classified into 2 tribes, *viz* Acantheae and Ruellieae. The tribe Ruellieae was classified into 4 subtribes, *viz* Ruelliinae (48 genera), Andrographinae (8 genera), Justiciinae (103 genera) and Barleriinae (9 genera). All of them are famous for medicinal purposes, especially both the subtribe Barleriinae and Andrographinae. Each subtribe in Thailand has two genera. They are as follows : Barleriinae (2 genera : *Barleria* L. and *Lepidagathis* Willd.) and Andrographinae (2 genera : *Andrographis* Wall. ex Nees and *Phlogacanthus* Nees) (Hansen, 1985).

2. The previous studies of Acanthaceae

Clarke (1885) studied in the subtribe Barleriinae and Andrographinae in India. The subtribe Barleriinae has two genera, *viz Barleria* L. and Lepidagathis Willd., totally 49 species. *Barleria* L. had 25 species, *viz Barleria acanthoides* Vahl, *B. amottiana* Nees, *B. buxifolia* L., *B. conspicua* Nees, *B. courtallica* Nees, *B. cuspida* Heyne., *B. grandiflora* Dalz., *B. gibsoni* Dalz., *B. hochstetteri* Nees, *B. involucrate* Nees, *B. lawii* T. Anders., *B. longiflora* L., *B. montana* Nees, *B. mysorensis*., *B. nitida* Nees, *B. noctiflora* L., *B. nutans* Nees, *B. pilosa* Wall., *B. polytricha* Wall., *B prionitis* L., *B. sepalosa* C.B. Clarke, *B. stocksii* T. Anders., *B. strigosa* Willd., *B. tomentosa* Roth. and *B. vestita* T. Anders. *Lepidagathis* Willd. had 24 species, *viz Lepidagathis cristata* Willd., *L. hamiltoniana* Wall., *L. mitis* Dalz., *L. trinervis* Nees, *L. lutea* Dalz.,

Lepidagathis spinosa Wight, *L. pungens* Nees, *L. clavata* Dalz., *L. prostrata* Dalz., *L. diffusa* Clarke, *L. rigida* Dalz., *L. cuspidata* Nees, *L. calycina* Hochst., *L. chlorostachya* Nees, *L. subuninervia* Clarke, *L. purpuricaulis* Nees, *L. dulcis* nees, *L. scariosa* Nees, *L. simplex* T. Anders., *L. hyalina* Nees, *L. linearis* T. Anders., *L. celanica* Nees, *L. walkeriana* Nees and *L. fasciculata* Nees. The subtribe Andrographinae had also two genera, such as *Andrographis* Wall. and *Phlogacanthus* Nees, totally 29 species. *Andrographis* Wall. had 19 species, *viz Andrographis paniculata* Nees, *A. subspathulata* Clarke, *A. elongata* T. Anders., *A. ovata* Benth., *A. tenuiflora* T. Anders., *A. alata* Nees, *A. stenophylla* Clarke, *A. wightiana* Arn. ex Nees, *A. macrobotrys* Nees, *A. viscosula* Nees, *A. neesiana* Wight, *A. stellulata* Clarke, *A. lineata* Nees, *A. lobelioides* Wight, *A. echioides* Nees, *A. glandulosa* Nees, *A. rothii* Clarke, *A. serpyllifolia* Wight and *A. beddomei* Clarke. *Phlogacanthus* Nees had 10 species, *viz Phlogacanthus curviflorus* Nees, *P. wallichii* Clarke, *P. tubiflorus* Nees, *P. parviflorus* T. Anders., *P. thyrsiflorus* Nees, *P. asperulus* Nees, *P. guttatus* Nees, *P. elongatus* T. Anders., *P. pubinervius* T. Anders. and *P. jenkinsii* Clarke.

Craib (1911) studied through the subtribe Barleriinae and Andrographineae for the flora of Thailand and Indochinese regions. It was reported that there were 4 species of *Barleria* L., *viz Barleria cristata* L., *B. lupulina* L., *B. siamensis* Craib and *B. strigosa* Willd. Besides, some of them were described and done for morphological studies.

Ridley (1923) studied in the family Acanthaceae in Malaysia by doing description of genera and species with the keys resolution, some morphological studies through fruit shape, seed setting, anther arrangement, number of calyxes, corolla shape. The subtribe Barleriinae has two genera, *viz Barleria* L. and *Lepidagathis* Willd., totally seven species, one variety. *Barleria* L. had three species, one variety, *viz Barleria prionitis* L., *B. conspicua* Nees and *B. siamensis* Craib var. *glabrescens*. *Lepidagathis* Willd. had four species, *viz Lepidagathis incurva* Don, *L. longifolia* Wight, *L. macrantha* Clarke and *L. yappii* Ridl., together with describing the morphological characters. The subtribe Andrographinae had also two genera, such as *Andrographis* Wall. and *Phlogacanthus* Nees, totally 29 species. *Andrographis* Wall. had two species, *viz Andrographis paniculata* Nees and *A. tenuiflora* T. Anders. *Phlogacanthus* Nees had one species, *viz Phlogacanthus brevis* Clarke.

Benoist (1935) enumerated the family Acanthaceae for Indochinese regions through the morphological studies with key to species emphasized on calyx, corolla, stamen and anther characters. It was reported that the subtribe Barlerinae had two genera such as *Barleria* L. and *Lepidagathis* Willd. *Barleria* L. had four species, *viz Barleria cristata* L., *B. lupulina* Lindl., *B. prionitis* L. and *B. strigosa* Willd. *Lepidagathis* Willd. had eight species, *viz Lepidagathis purpuricaulis* Nees, *L. thorelii* R. Ben., *L. falcata* Nees, *L. incurva* Don, *L. fasciculata* Nees, *L. cambodiana* R. Ben., *L. mendax* R. Ben. and *L. parviflora* Blume. The subtribe Andrographinae had two genera such as *Andrographis* Wall. and *Phlogacanthus* Nees. *Andrographis* Wall. had two species, *viz Andrographis paniculata* Nees and *A. tenuifolia* T. Anders. *Phlogacanthus* Nees had thirteen species, *viz Phlogacanthus poilanei* R. Ben., *Phlogacanthus turgidus* Nicholson, *P. geoffrayi* R. Ben., *P. harmandii* R. Ben.,

Phlogacanthus cornutus R. Ben., *P. annamensis* R. Ben., *P. curviflorus* Nees, *P. datii* R. Ben., *P. asperulus* Nees, *P. colaniae* R. Ben., *P. pyramidalis* R. Ben., *P. pubiflorus* Lindau and *P. abbreviatus* R. Ben.

Imlay (1939) explored and studied in the family Acanthaceae in Thailand and they were identified as *Pseuderanthemum axillare* Imlay, *P. bracteatum* Imlay, *P. crenulatum* Imlay, *P. glomeratum* Imlay, *P. siamensis* Imlay, *P. longistylum* Nees and *Thysanostigma siamense* Nees.

Bremekamp and Nannenga-Bremekamp (1948) studied in the family Acanthaceae at Archipelago and New Guinea. It was reported that there were 8 genera, *viz Ruellia* L., *Arrhostoxylum*, *Stephanophysum*, *Dipteracanthus*, *Nothoruellia* Bremek., *Pararuellia* Bremek., *Leptosiphonium* F. Muell. and *Eranthemum* L.

Bremekamp (1948) studied in the family Acanthaceae in Java Islands. It was reported that there were 2 genera such as *Barleria* L., and *Lepidagathis* 4 taxa, *viz Lepidagathis javanica* Blume, L. *paviflora* Blume, *L. eucephala* Miq. var. *glandulosa* Brem. and *L. eucephala* Miq. var. *linearifolia* Brem.

Backer *et al.* (1965) studied in the family Acanthaceae in Java, Indonesia and both of plant description and key to species were constructed. The subtribe Barleriinae had two genera, such as as *Barleria* L. and Lepidagathis Willd., totally ten species four varieties. *Barleria* L. had six species one variety, *viz Barleria cristata* L., *B. dichotoma* Roxb., *B. lupulina* L., *B. involucrate* Nees var. *elata* C.B. Clarke, *B. prionitis* L. and *B. strigosa* Willd. *Lepidagathis* Willd. had four species, 3 varieties, *viz Lepidagathis eucephala* Miq. var. *glandulosa* Bremek., *L. backeri* Bremek., *L. billardieriana* Nees, *L. javanica* Blume var. *javanica* and *L. javanica* Blume var. *parviflora* (Blume) Bremek. The subtribe Andrographinae had only one genus, Andrographis Nees, which had two species, *viz Andrographis paniculata* (Burm.f.) Nees, *A. laxiflora* (Blume) Lindau.

Brummitt and Seyani (1976) studied in the genus *Barleria* L. in tropical Africa. It was reported that there were two species, *viz Baleria sunzuana* Brummitt & Seyani and *B. lactiflora* Brummitt & Seyani.

Hansen (1985) studied in the family Acanthaceae and they were classified into three tribes, *viz* Barleriinae, Isoglossinae and Justiciinae. A number of 40 genera and 230 species were identified by the characters of corolla, fertile and sterile stamen, especially the subtribe Barleriinae has many characters, such as upper corolla lobe not attached to fertile stamen which have 4 or 2 stamen and two number of sterile stamen attached to the corolla. The habits of this family are shrubs, herbs, rarely vines. Leaves are arranged in the opposite – decussate type, entire, eligulated. Flowers are arranged in solitary or inflorescence as raceme or cyme. The fertile ones have five calyxes and corolla fused at base, separated in five lobes at apex. The pistil has it ovary setting in superior position and it composes of two fused carpel. Each one has two ovules or more. The style has only one stalk and its top separated into two parts. The fruit is a capsule type which is longitudinally dehiscent from apex to

the end. The seed has a funicle growth from the ovule stalk which looks like a hook called a jaculator.

Hansen (1985) collected plants in the subtribe Barleriinae in Thailand. It was reported that there were nine genera and twenty one species. The characters of *Barleria* L. were described as the lower corolla not attached to the stigma, and the number of stamen in two or four ones.

Madhusoodanan and Singh (1992) studied in the genus *Lepidagathis* Willd. in south India and it was reported a new species as *Lepidagathis keralensis* P.V. Madhusoodanan & N.P. Singh.

Balkwill and Balkwill (1996) studied and identified plants in the infrageneric level of *Barleria* L. It was classified in two subgenera, *viz Barleria* L. and *Prionitis* Oerst. Seven sections were classified as *Barleria* L., *Cavirostrata* M. Balkwill,, *Chrysothrix* M. Balkwill, *Fissimura* M. Balkwill, *Prionitis* Oerst., *Somalia* (Oliv.) Lindau and *Stellatohirta* M. Balkwill. The above studied is to identify the plants in this genus and study corolla arrangement, stigma structure, anther position, fruit shape, seed hook appearing, seed wall and number of seeds.

Cramer (1998) studied in the family Acanthaceae in Java, Indonesia and both of plant description and key to species were constructed. The subtribe Barleriinae had two genera, *viz Barleria* L. and *Lepidagathis* Willd., totally sixteen species four varieties. *Barleria* L. had twelve species three varieties, *viz Barleria mysorensis* Roth, *B. lanceata* (Forssk.) C. Chr., *B. tomemtosa* Roth. var. *acuminata* (Wight ex Nees) Clarke, *B. strigosa* Willd., *B. nitida* Nees, *B. prionitis* L., *B. involucrata* Nees, *B. cristata* L., *B. arnottiana* Nees var. *arnottiana*, *B. arnottiana* Nees var. *glabra* Trimen, *B. vestita* T. Anders., *B. nutans* Nees and *B. lupulina* L. *Lepidagathis* Willd. had four species, one variety, *viz Lepidagathis hyalina* Nees var. *lophostachyoides* Nees, *L. ceylanica* Nees, *L. walkeriana* Nees and *L. fasciculata* (Retz.) Nees. The subtribe Andrographinae had only one genus, Andrographis Nees, which had four species, four varieties, *viz Andrographis paniculata* (Burm.f.) Wall. ex Nees var. *paniculata*, *Andrographis paniculata* (Burm.f.) Wall. ex Nees var. *glandulosa* Trimen, *A. alata* (Vahl) Nees, *A. macrobotrys* Nees var. *macrobotrys*, *A. macrobotrys* Nees var. *ceylanica* (Nees) Cramer and *A. echioides* (L.) Nees.

Scotland and Vollesen (2000) studied in the family Acanthaceae through the pollen morphology, corolla aestivation, and its phylogeny. It was classified by retinacula funiculi, fruit dehiscence, cystoliths in epidermal cells, node of stem and branch, outer seed coat, pore, groove, depth and ornamentation of pollen, anther arrangement and dehiscence, position of style, and corolla arrangement. For example, Two genera of *Barleria* L. and *Lepidagathis* Willd. were classified in the subtribe Barleriinae as a results of corolla aestivation with quincuncial type.

Chaikong (2001) studied in the subtribe Barleriinae (Acanthaceae) in Northeastern Thailand. The morphological characters, ecology, distribution, were six genera 17 species, *viz Asystasia gangetica* T. Anders., *A. salicifolia* Craib, *Barleria strigosa* Willd., *B. cristata* L., *B. lupulina* Lindl., *B. prionitis* L., *Clinacanthus nutans*

(Nees) Lindau, *Codonacanthus pauciflorus* Nees, *Graptophyllum pictum* Griff., *Pseuderanthemum axillare* Imlay, *P. carruthersii* Guill., *P. couderci* R. Ben., *Pseuderanthemum graciliflorum* Radlk., *P. parishii* (C.B. Clarke) Lindau, *P. reiculatum* (Hort. ex Gard.) Radlk., *P.* sp.1 and *P.* sp.2

3. **Morphological Characters**

1) Habit

The habit of the subtribe Barleriinae was reported *Barleria* L. is herb or shrub (Cramer, 1998) or suffrutices, rarely climbers (Balkwill and Balkwill, 1996) but *Lepidagathis* Willd. is perrenial herb or shrub. (Cramer, 1998)

The habit of the subtribe Andrographinae was reported that *Andrographis* Nees is normally herb but *Phlogacanthus* Nees is Undershrubs. (Ridley, 1923)

2) Leaf

Barleria L. The leaves are simple, opposite and decussate, entire and glabrous. The stipules are lacking. They are oppositely or whorled arranged The petioles are short. The leaf texture is thin. The veins are reticulated arranged. The leaves of some species in the subtribe Barleriinae, such as *Barleria prionitis* L. has the obvious spines. (Cramer, 1998)

The leaf anatomy are reported as follows: the abaxial epidermis is papillose, or not. Mucilaginous epidermis is absent. Stomata are mainly confined to one surface, or on both surfaces; diacytic. Hairs are present; eglandular, glandular, unicellular, or multicellular. The unicellular hairs are branched, or unbranched. Multicellular hairs are branched, or unbranched. Adaxial hypodermis are rarely present, or absent. The lamina is dorsiventral, or rarely isobilateral, without secretory cavities. Most of the Cystoliths are very commonly presented by showing as streaks in the lamina (Fahn, 1990). Thery are three types, i.e. double cystolith, found in *Barleria* L., *viz Barleria prionitis* L.; *Barleriola* Oerst. And *Crabbea* Harv.; solitary, round cystolith, found in *Asystasia* Blume, *viz Asystasia scandens* Hook. and *Codonacanthus* Nees; solitary elongated cystolith found in *Graptophyllum* Nees (Metcalfe และ Chalk, 1957).

3) Flower

The flowers are bisexual, zygomorphic, and usually are associated with conspicuous, often brightly colored bracts. The calyx is usually deeply 4-5 lobed or sometimes is highly reduced with more numerous minute teeth. The corolla is sympetalous, usually 5-merous, mostly zygomorphic, and commonly 2 lipped. The androecium usually consists of 4 didynamous stamens or only 2 stamens adnate to the corolla tube or epigynous zone, alternate with the lobes. The gynoecium consists of a single compound pistil of 2 carpels, a single style, and a superior ovary with 2 locules, each with usually 2-10 axile ovules in one or two collateral vertical tiers. An annular nectary disk is usually found around the base of the ovary.

4) Fruit

The fruit is commonly an elastically dehiscent loculicidal capsule. The seed stalk or funiculus of each seed is modified into a hook shaped jaculator or retinaculum that functions in flinging out the seeds during dehiscence. (Cramer, 1998)

5) Seed and seed Dispersion

The features of seeds of Acanthaceae are shape, size, and testa structure that plays an important role for the taxonomic feature, but the seeds in systematic of this family remain poorly know. Some comprehensive studies of testa at the generic level have been completed *e.g., Peristrophe* (Balkwill *et al.,* 1986), *Siphonoglossa* (Immelman, 1990) and *Thunbergia* (Balkwill & Campbell – Young, 1999).

Besides, there are many genera *viz Nelsonia* R. Br., *Thunbergia* Retz., *Acanthus* L., *Ruellia* L. which have retinacula or ejaculator and hook for helping seeds to disperse into natural habitat. (Pandey, 2005)

4. Palynological Study

Erdtman (1966) studied the pollen morphology in the family Acanthaceae and it was reported they were isopolar or lateral symmetrical. There are two apertures or more which called a dicolpate type.

Raj (1973) studied pollens of some genera of the family Acanthaceae in India, Malaysia, the Philippines, New Guinea and Congko by light microscope examinining. The result showed that *Barleria acuminata*, *B. bocifolia* L., *B. cuspidata* Heyne, *B. longiflora* L., *B. montana* Nees, *B. mysorensis* Roth, *B. tomentosa* Roth and *B. nitida* Nees were examined as a tricolpate type with reticulate exine sculturing.

Scotland and Vollesen (2000) studied and identified plants in the family Acanthaceae , especially in the subtribe Barleriinae and Andrographinae. The result showed that the pollen morphology of *Barleria* L. and *Lepidagathis* Willd. (subtribe Barleriinae) were examined as a tricolpate type, called tri-brevicolporate, found in *Barleria micans* Nees, for example, with an open reticulate tectum. The pollen type of *B. prionitis* L. was tricolpate type and the exine has gemma. The pollen of *Lepidagathis hyalina* Nees was examined as a tricolporate type and the eine sculturing was also the same as *Barleria micans* but there were finely arranged at the nearby apertures. The pollen of *Lepidagathis alopercuroides* R. Br. ex Griseb. was the type as *Lepidagathis hyalina* except the central area of it apertures found less.

5. Phytochemical Study

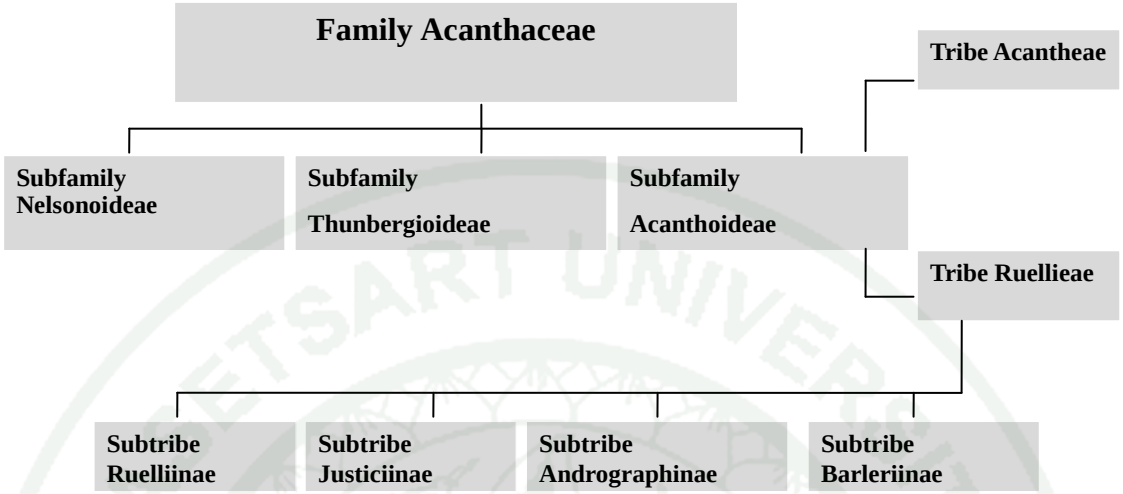

Figure 1 Classification of Acanthaceae
Source: (Scotland & Vollesen, 2000)

Kanchanapoom *et al*. (2006) reported that a phytochemical study on the extraction of *Barleria strigosa* Willd. from the whole plant could be found a phenylethanoid (4-hydroxyphenylethyl 4-O-beta-D-glucopyranosyl-(1-->3)-O-alpha-L-rhamnopyranoside) and an iridoid (10-O-trans-coumaroyl-eranthemoside).

Gorter, (1911) studied on the chemistry of *A. paniculata* during various times. An analysis of the whole plant gave the following lactones (dry basis): andrographolide[1] ($C_{20}H_{30}O_5$; mp 230-239˚C), 0.6; 14-deoxy-11-oxoandrographolide[2] ($C_{20}H_{28}O_5$, mp 98-100˚C), 0.12; 14-deoxy-11, 12-didehydroandrographolide[3] ($C_{20}H_{30}O_4$, mp 203-204˚C), 0.06; 14-deoxyandrographolide[4] ($C_{20}H_{30}O_4$, mp 175˚C), 0.02%; and a non-bitter constituent, neoandrographolide[5] ($C_{26}H_{40}O_8$, mp 167-168˚C), 0.005%. The leaves contain andrographolide (yield, 1%). From the petroleum ether extract of the leaves from Bangladesh, the following have been isolated: α-,β-unsaturated lactone, homoandrographolide ($C_{22}H_{32}O_9$, mp 115˚C), andrographosterol ($C_{23}H_{38}O$, mp 135˚C), andrographane ($C_{40}H_{82}$, mp 67-68˚C), andrographone ($C_{32}H_{64}O$, mp 85˚C), a wax and two esters containing hydroxy groups.

Besides, the roots gave apigenin- 7, 4'- di-O-methyl ether, andrographolide and a new natural flavone, 5-hydroxy 7,8,2',3'- tetramethoxy flavone ($C_{19}H_{18}O_7$, mp 150-151˚C; yield, 0.006%). They also contain a monohydroxy trimethyl flavone, andrographin ($C_{18}H_{16}O_6$, mp 190-191˚C) and a dihydroxy-di-methoxyflavone, panicolin ($C_{17}H_4O_6$, mp 263-264˚C). The presence of α-sitosterol is also reported.

Shen *et al.* (2006) reported that six new *ent*-labdane diterpenoids, 3-*O*-β-D-glucopyranosyl-14,19-dideoxyandrographolide,14-deoxy-17-hydroxy andrographolide, 19-*O*-[β-D-apiofuranosyl(1→2)-β-D-glucopyranoyl]-3,14-dideoxyandrographolide, 3-*O*-β-D-glucopyranosylandrographolide (4), 12*S*-

hydroxyandrographolide (5), and andrographatoside (**6**), together with 17 known analogues, were isolated from the aerial parts of *Andrographis paniculata*. The structures of 1-6 were determined by spectroscopic data analysis. All compounds isolated were evaluated for their inhibitory activity against several bacterial and fungal strains.

Yadava (2006) reported that the bioactive studies through leaf extracts from *Lepidagathis hyalina* Nees can control microbes, causing the plant diseases effectively. The active ingredients of the above plant comprised a triterpenoid saponin (3-beta-O-[alpha-L-rhamnopyranosyl(1-->4)-O-beta-D-glucopyranosyl]16-alpha-hydroxy-olean-12-en(13)-28-oic acid).

6) Ecology and Distribution

It was reported that most of them growed in tropical and subtropical zones especially in moist area. (Pandry, 2005)

7) Uses

It was reported that *Barleria lupulina* Lindl. can be cured an inflammation, due to snake's toxins and toothache by piercing the whole plants to cover them on the wound. *Barleria prionitis* L. has the properties for urine secretion, healing the eczema, abscess and pertussis (Department of Medical Sciences, 1995)

A test of the effectiveness of *Barleria lupulina* Lindl. on the protection against the Herpes simplex virus, HSV) showed that its extraction can control HSV type 2 strain G directly. The desistance of the growth of plague and virus products in infected cells was clearly effective, when they touched directly to the extraction not less than 20 hour. (Panpisutchai, 1999)

Phutiyanant (1982) reported that *Barleria lupulina* Lindl. could be used by piercing the leaves finely and mixing with distilled liquor to cover the abscess and cure the symptom form bug and nettle-rash.

A pharmacological study on Herpes simplex virus type 2 (HPV2) was carried out to use the methanol extraction from leaves of *Barleria lupulina* Lindl., which could control the growth of HVP2 in the infectious patients effectively, due to the iridoids in this plant. (Yoosook *et al.*, 1999)

Somprasong (2014) reported that the plants belonging to family Acanthaceae were considered important plant for their medicinal value by the people across North, Central and North-eastern Thailand. A total of 39 species and 2 varieties were studied for their uses.

MATERIALS AND METHODS

1. Taxonomic Treatment

1.1 Literature and Herbarium Study

The literature and herbarium specimens of the subtribe Barleriinae (both genera of *Barleria* L. and *Lepidagathis* Willd.) and the subtribe Andrographinae (both genera of Andrographis Wall. and Pholgacanthus Nees) examined at Thai and foreign herbaria as follows: Bangkok Herbarium, Department of Agriculture (BK), Forest Herbarium, National Park, Wildlife and Plant Conservation Department (BKF), Queen Sirikit Botanic Garden Herbarium, The Botanical Organization, Ministry of Natural Resources and Environment (QBG), the Biological Department Hebarium, Chiang Mai University (CMU), Prince of Songkhla University Herbarium (PSU), Royal Botanic Gardens, Kew (K).

1.2 Field Survey and Specimens Collection

Field Surveys and Specimen collections of the subtribe Barleriinae (both genera of Barleria L. and Lepidagathis Willd.) and the subtribe Andrographinae (both genera of *Andrographis* Wall. and *Pholgacanthus* Nees) are conducted throughout the country by choosing the three substitute conserved area from each region, *viz* the North (Chiang Dao National Park, Chiang Mai Province, Nam Tok Mae Surin National Park, Mae Hong Son and Phu Nang National Park, Pha Yao Province); the Northeast (Phu Luang Wildlife Sanctuary, Loei Province, Phu Pha Yon National Park, Sakon Nakhon and Mukdahan Province, Na Yung – Nam SomNational Park, Udon Thani Province); the Central (Kaeng Kachan National Park, Phet Buri Province, Chalerm Rattana Kosin National Park, Kanchana Buri Province and Khao Sam Roi Yot National Park, Prachuap Khiri Khan Province), the East (Pang Sida National Park, Prachin Buri Province, Khao Chamao – Khao Wong National Park, Rayong Province and Khao Kitchakut National Park, Chantha Buri Province) and the South (Khao Nan National Park, Nakhon Si Thammarat Province, Si Phang Nga National Park, Phang Nga Province and Kaeng Krung National Park, Surat Thani Province)

2. Morphological Study

Measurement of vegetative and reproductive features of dried specimens collected by the author, and herbarium specimens deposited in the above Thai and foreign herbaria are carried out by using a hand ruler or scale calibrated in cm and mm under the stereomicroscope for the characters of indumentum, leaves and flowers. To study morphological characters clearly, the specimens should be usually boiled at 60-80 degree Celsius to be more softer. For seed morphological study, the optical observation measurements were made out using an Olympus SZX9 stereomicroscope (SM). At least 5 seeds of every fresh specimen were measured to cover their variation. Seeds was affixed to aluminum stubs with double-sided carbon tape, then sputter-coated with a pla tinum mixture, and observed with a Hitashi model SU 8020 SEM. Terminology follows Erdtman (1986).

Illustrations and photographs are provided for clarification. The herbarium specimens together with the voucher specimens are identified by taxonomic literature and the comparison with the type specimens. Preparation the keys to subtribe, genera and species based on the significant morphological characters are constructed to prove their taxonomic units. The dried specimens are mounted on herbarium sheets with the label and registered for keeping in the main Thai herbaria such as BK, BKF, QBG, PSU, CMU, and K respectively

3. Palynological Study

Pollen materials are obtained from fieldwork collected by the author to be examined both with the light microscope (LM) and SEM. For LM, pollen are prepared through the Hopwood & Milne' technique (1991), The samples were fixed in 3 % phosphate buffere gluteraldehyde and 1 % osmium tetroxide. (Hopwood and Milne, 1991). The SEM study was conducted by putting droplet of pollen-ethanol sputter-coated with a platinum. And then, they were affixed to aluminum stubs with double-sided carbon-tape and sputter-coated with a platinum, and observed with a scanning electron microscope (SEM) (Hitashi model SU 8020).

Five number of them are measured with the following characters : size in diameter and spine length (μm). Mature seeds of 30 species of the genus *Justicia* in Thailand were collected in the field. Voucher specimens from the fieldwork were deposited in BK (Table). Optical observation measurements were made out using an Olympus SZX9 stereomicroscope (SM). At least 5 seeds of every fresh specimen were measured to cover their variation. Seeds was affixed to aluminum stubs with double-sided carbon tape, then sputter-coated with a platinum mixture, and observed with a Hitashi model SU 8020 SEM. Terminology follows Graham (1988). The samples were fixed in 3 % phosphate buffere gluteraldehyde and 1 % osmium tetroxide. (Hopwood and Milne, 1991). The SEM study was conducted by putting droplet of pollen-ethanol sputter-coated with a platinum. And then, they were affixed to aluminum stubs with double-sided carbon-tape and sputter-coated with a platinum, and observed with a scanning electron microscope (SEM) (Hitashi model SU 8020).

4. Chromatographical Study

4.1 Sample collection and herbarium specimen comparison

Whole plants of *Barleria cristata* and *B. strigosa* utilized in this study were collected from Chiang Mai and Tak Province in November 2007. Botanical identification was achieved through comparison with specimens (No 187, 62776, 66063, 66275, 66278, 81343, 83250, 102920 for *Barleria cristata* and No 3043, 17590, 41995, 47716, 58168, 66288, 75593, 75595, 94959, 94960, 111205 *B. strigosa*) (BKF) for deposited in the Bangkok Forestry Herbarium (BKF).

4.2 Sample extraction

Stems, roots and leaves were dried at room temperature. They were cut into pieces and ground to a coarse powder. The powdered leaves, stems, roots and leaves materials (1g/each) were extracted with 95% EtOAc 10 ml at room temperature for one day. Then each was filtrated and soaked with 95% EtOAc to repeat extraction

again. The filtrated solution was dried in a rotary evaporator to give each in 5 crude extracts for stems, roots and leaves, totally 15 samples. They were dissolved again with 1 ml EtOAc and they were employed for TLC.

4.3 Chromatographic Techniques

TLC was employed for chemical profiles. The crude extracts were performed on thin layer chromatography plates with precoated silica gel 60 F_{254} (Merck) plates by TLC Auto Spotting and separated with 20 µl per sample The plates were developed in a solvent system of 3:1 Chloroform : EtOAc. After the solvent took a samples ascended in the appropriate level, the TLC plate was left to keep dry. The chromatograms were observed under TLC Densitometer (CAMAG TLC Sanner3) and sprayed with anisaldehyde reagent, then observable spots were outlined with a pencil. Spots were evaluated with respect to Rf values and spot colors. The Rf value and color of each spot in a profile sample was labeled by numbers (1-15). Definition of spot colors followed Beentje (2010). For comparison of chromatogram profiles, the same Rf values and colours were marked as the same numbers.

RESULTS AND DISCUSSION

1. General Morphology

1.1 Habit

Most of the subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand are ocassionally small shrubs and herbs. The habit for herb can be divided in erect, procumbent and decumbent.

Erect herbs could be found in *Lepidagathis dissimilis*, *L. fasciculata*, *L. incurva*, *L. purpuricaulis*, *Andrographis laxiflora*, *A. paniculata*, *Gymnostachyum coriaceum*, *G. decurrens*, *G. gracile*, *G. signatum*, *G. venustum*.

Decumbent herb could be found in *Lepidagathis chiengmaiensis*.

Procumbent herb could be found in *Graphandra procumbens*.

Creeping Herb could be found in *Gymnostachyum leptostachyum* and *G. trilobum.*

Erect shrub could be found in *Barleria biloba*, *B. cristata*, *B. lupulina*, *B. prionitis*, *B. siamensis*, *B. strigosa*, *Chroesthes bracteata*, *C. lanceolata*, *Gymnostachyum canescens*, *Lepidagathis chlorostachya*, *L. falcata*, *Phlogacanthus abbreviatus*, *P. asperulus*, *P. brevis*, *P. curviflorus*, *P. murtonii*, *P. paniculatus*, *P. pauciflorus*, *P. pedunculatus*, *P. pulcherrimus*, *P. racemosus*, *P. rectiflorus*, *P. vitellinus.*

1.2 Leaf morphology

The features of trichomes are the evidences to clarify leaf morphology. The foliar trichomes of Acanthaceae were different among many genera. A number of reprentative species among two subtribes, Subtribe Barleriinae, *viz Chroesthes bracteata* and *C. lanceolata* and Subtribe Andrographinae, *viz Andrographis paniculata*, *Phlogacanthus asperulus*, *P. curviflorus*, *P. paniculatus*, *P. pauciflorus*, *P. pedunculatus*, *P. pulcherrimus*, *P. rectiflorus* and *P. vitellinus* were investigated (Table 1). The result showed that the surface of leaves can be found glandular and non-glandular trichomes, cystoliths in different species. They were found at the adaxial surface (upper surface) and abaxial surface (lower surface).

Glandular trichomes were found with various types, 4-6 cells in each species. (Figure 2 and 3)

Non glandular trichomes were found in most species. They were found at both lower and upper surfaces, *viz Andrographis paniculata, Chroesthes bracteata*, *Phlogacanthus asperulus*, *P. curviflorus, P. pulcherrimus.* They were found only at upper surface in *P. pauciflorus*. None of them were found in *Phlogacanthus peduculatus* and *P. vitellinus*. (Figure 2)

Table 1 List of specimens examined for SEM leaf morphology

Taxa	Voucher Specimen	Locality
Andrographis paniculata	Winai Somprasong 052160213-4 (BK)	Mae Ramat District, Tak Province
Chroesthes bracteata		
C. lanceolata	Winai Somprasong 013070154-1 (BK)	Song Khwae District, Nan Province
Phlogacanthus asperulus	Winai Somprasong 017120112-1 (BK)	Chae Son District, Lampang Province
P. curviflorus	Winai Somprasong 052080112-10 (BK)	Tha Song Yang District, Tak Province
P. paniculatus	Winai Somprasong 013030108-2 (BK)	Tambon Saentong, Tha Wang Pha District, Nan Province
P. pauciflorus	Winai Somprasong 014090208-7 (BK)	Tambon Thungkluai, Phu Sang District, Phayao Province
P. pedunculatus	Winai Somprasong 055250212-1 (BK)	Ban Bung, Ban Kha District, Ratcha Buri Province
P. pulcherrimus	Winai Somprasong 012121213-5 (BK)	Mae Tang District, Chiang Mai Province
P. rectiflorus	Winai Somprasong 062280308-2	Tambon Wangtako, Langsuan District, Chumphon Province
P. vitellinus	Winai Somprasong 041190114-8 (BK)	Tambon Krating, Khao Kitchakut District, Chantha Buri Province

Cystoliths were investigated in various shapes, elongate shape could be found in *Phlogacanthus curviflorus*, both lower and upper surfaces, oblong in *Andrographis paniculata*, *Phlogacanthus curviflorus*, *P. pedunculatus*, both lower and upper surfaces). The other species could not be found clearly in *Chroesthes bracteata* such as *C. lanceolata*, *Phlogacanthus asperulus*, *P. paniculatus*, *P. pauciflorus*, *P. pulcherrimus*, *P. rectiflorus* and *P. vitellinus* (Figure 2 and 3).

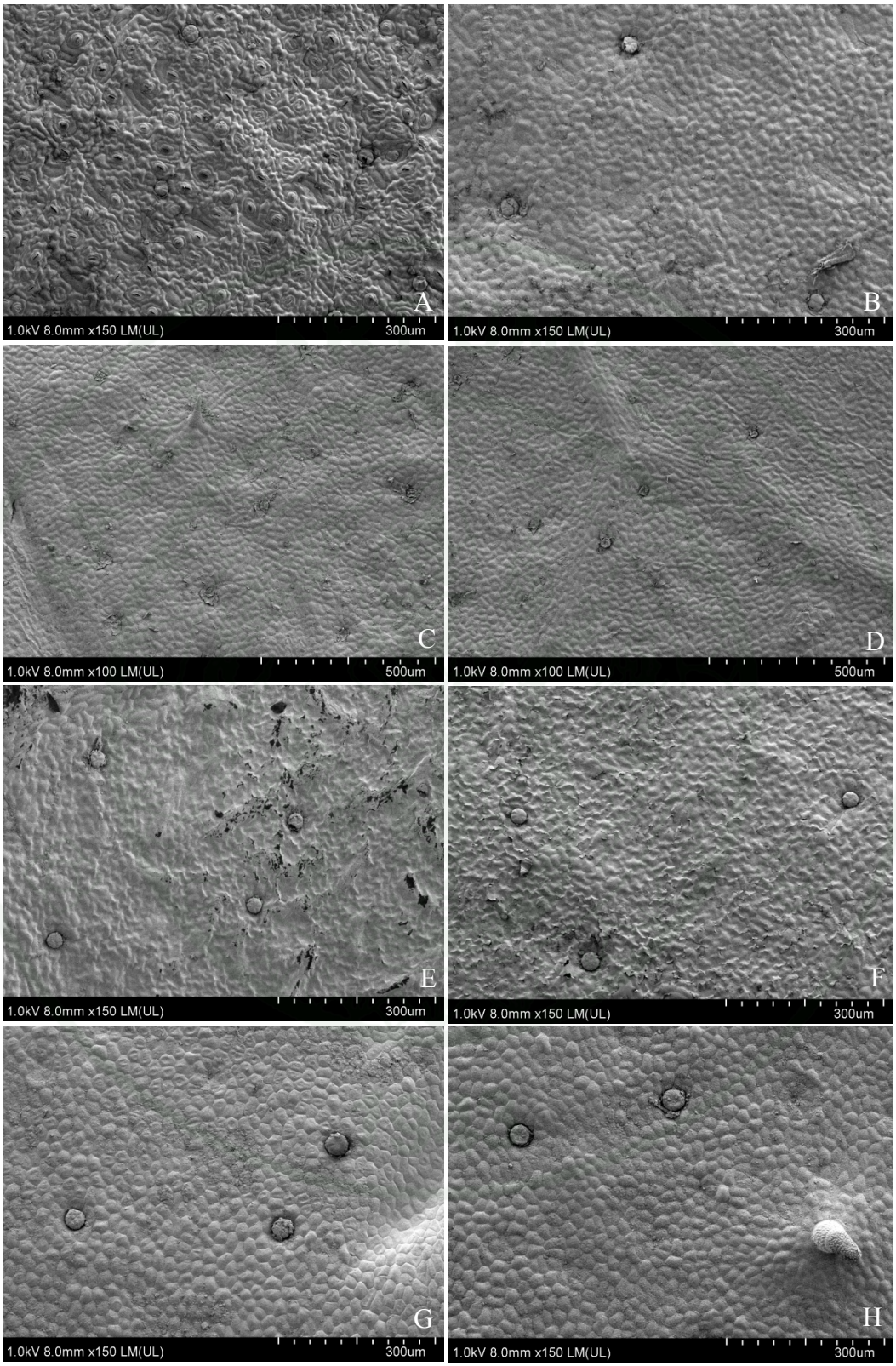

Figure 2 SEM Micrographs of leaf surface of *Andrographis paniculata* (A=L, B=U); *Chroesthes bracteata* (C=L, D=U); *C. lanceolata* (E=L, F=U); *Phlogacanthus asperulus* (G=L, H=U), L = lower epidermis, U = upper epidermis

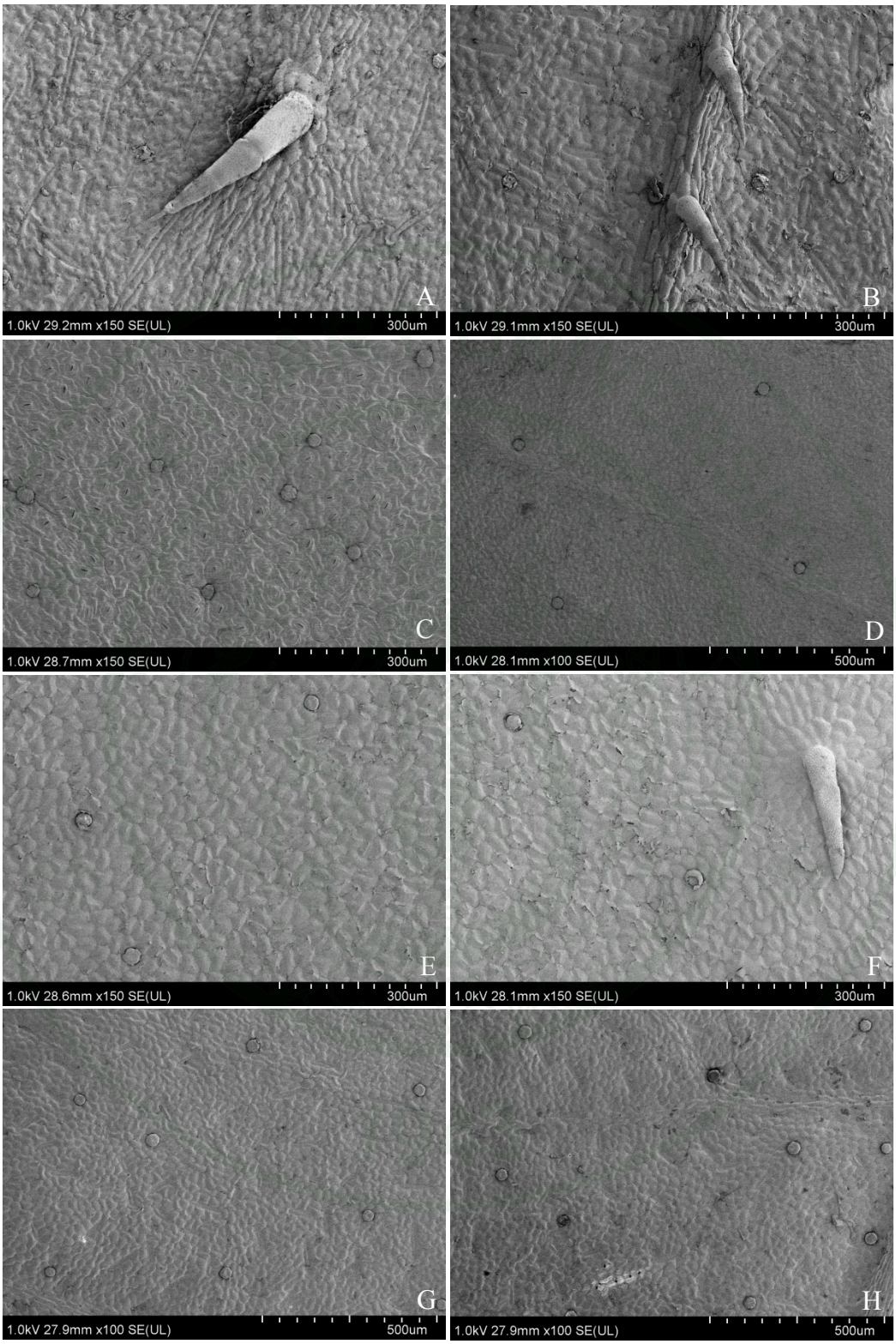

Figure 3 SEM Micrographs of leaf surface of *Phlogacanthus asperulus* (A=L, B=U); *P. curviflorus* (C=L, D=U); *P. paniculatus* (E=L, F=U); *P. pauciflorus* (G=L, H=U). L = lower epidermis, U = upper epidermis

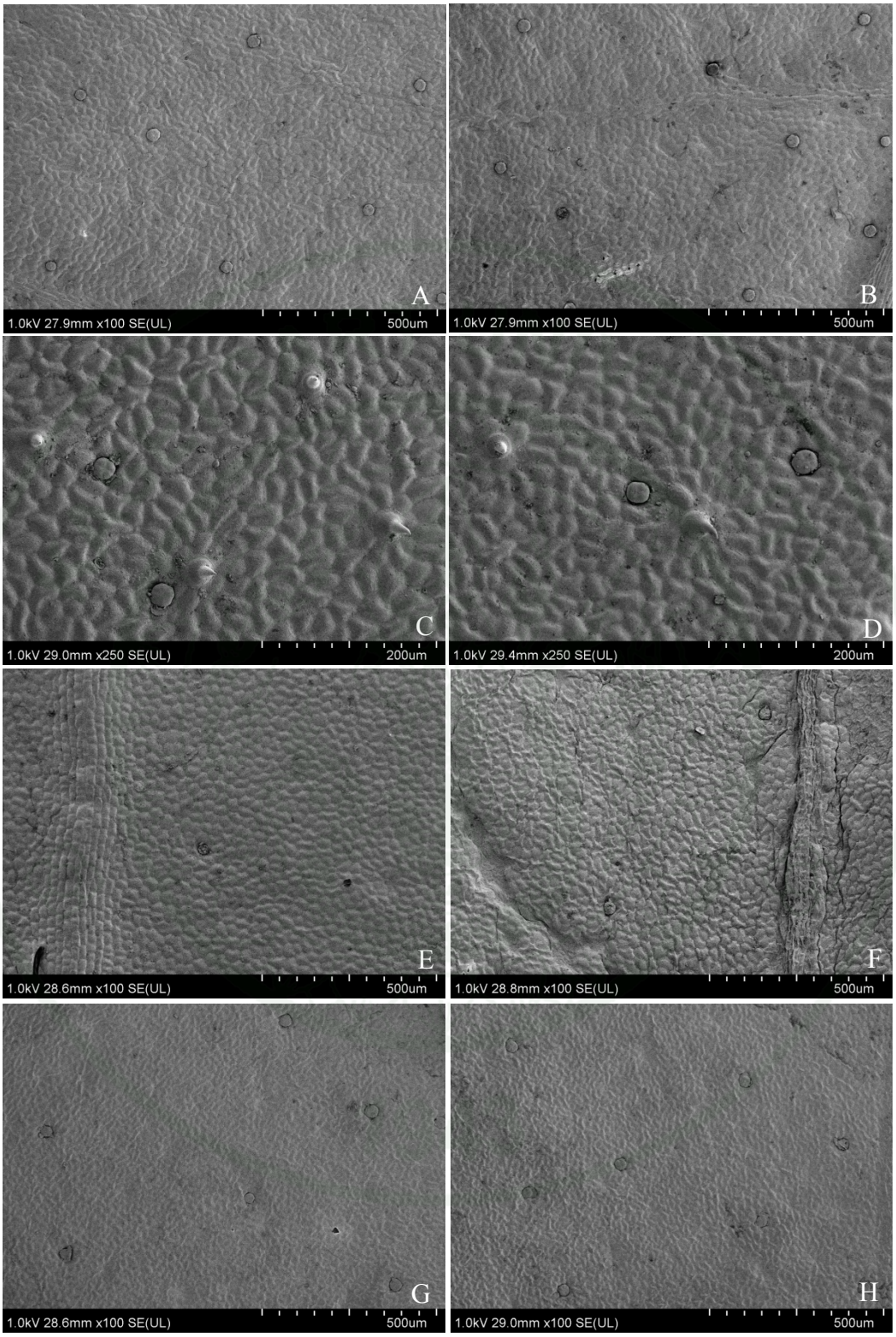

Figure 4 SEM Micrographs of leaf surface of *Phlogacanthus pedunculatus* (A=L, B=U); *P. pulcherrimus* (C=L, D=U); *P. rectiflorus* (E=L, F=U); *P. vitellinus* (G=L, H=U). L = lower epidermis, U = upper epidermis

1.3 Floral morphology

The floral morphology of Acanthaceae in two subtribes differ in each other. The features of corolla aestivation are highly recognized among various genera of Acanthaceae. The subtribe Andrographinae is an adscending cochlear aestivation but subtribe Barleriinae is a quinquncial aestivation (Scotland & Vollesen, 2000). The result showed the characters of inflorescence among two subtribes are different in each other (Table 2).

Subtribe Andrographinae:

Four genera of the subtribe Andrographinae (*Andrographis*, *Graphandra*, *Gymnostachyum* and *Phlogacanthus*) have distinct floral characters (calyx, corolla and stamen) as follows:

1. Calyx deeply 5 - lobed, small, segments equal or subequal were found in 3 genera but *Graphandra* was found as calyx deeply 4 – lobed.
2. Corolla subequally 5 – lobed was found in *Andrographis* and the other were found as corolla bilabiate (*Graphandra* and *Gymnostachyum*), but corolla tube ventricose found in most of *Phlogacanthus.*
3. Bract and bracteole was found similar among four genera but some species were found absent in *Andrographis* and *Phlogacanthus*.
4. Stamen 2 were found among four genera, They are free except *Graphandra*. adnate to corolla tube.
5. Ovules 6-12 were found in *Andrographis*, 12 in *Graphandra*, 6 – many in *Gymnostachyum* and 10-16 in *Phlogacanthus*.

Subtribe Barleriinae:

Three genera of the subtribe Barleriinae (*Barleria*, *Chroesthes* and *Lepidagathis*) have distinct floral characters (calyx, corolla and stamen) as follows:

1. Calyx 5 - lobed, large, segments equal or unequal were found in *Lepidagathis* Calyx segments 4, 2 outer large, 2 inner small were found in *Barleria*.
Calyx segment 5, sepals in opposite pairs, bearing outer, interior and lateral ones were found in *Chroesthes*.
2. Corolla sub-equally 5-lobed were found in *Barleria.* Corolla 2- lipped, upper 2-lobed, lower 3-lobed were found in *Chroesthes.* Corolla bilabiate were found in *Lepidagathis*.
3. Bracts were found among three genera some species are absent in *Barleria.* Besides, spinous bracts were found in some species of *Barleria.*
4. Stamen connate at the base were found in *Barleria* and *Lepidagathis.* Number of stamen wer found 4 and 2 in in *Barleria* and *Lepidagathis*, respectively. Stamen not connate at the base were found in *Chroesthes*.
5. Ovules 4 were found in *Barleria*, 2 *Chroesthes* and 6 to many in *Lepidagathis.*

1.4 Fruit morphology

The fruits of representative species are diferrent in shape and size. The result showed that the shape vary into two types, terete and compressed. The fruit

compressed was found in *Andrographis laxiflora*, *A. paniculata*, *Barleria cristata*, *B. siamensis*, *Lepidagathis falcata*. The fruit terete was found in *Gymnostachyum canescens*, *Phlogacanthus curviflorus*, *P. paniculatus*, F. *P. pedunculatus*, *P. pulcherrimus*, *P. rectiflorus*, *P. vitellinus*) (Figure 8).

The dehiscence of fruit are relatively similar among two subtribes in terms of deshiscence to the base but one has spitted into 2 valves while another one has 2 vales still fixed at the base. The features of fruit dehiscence are relatively among genera of two subtribes.

The fruit deshiscence to the base and valves still fixed at the base was found in most species except *Lepidagathis falcata* (Figure 8L). The fruit contains a retinacula that acts to throw the seeds from the fruits.

The calyx was always persistent in fruits except *Lepidagathis falcata* (Figure 8K).

The fruit deshiscence to the base and valves separation was found in *Phlogacanthus paniculatus* (Figure 8E)and *P. rectiflorus* (Figure 8H).

Table 2 Floral characters of the subtribe Andrographinae and Barleriinae (Acanthaceae) in Thailand

Taxa	Inflorescence					
	bract	bracteole	calyx	corolla	stamen	ovule
Subtribe Andrographinae						
1. *Andrographis*	2	2/ absent	small, calyx deeply 5-lobed	corolla sub-equally 5-lobed	2	6-12
2. *Graphandra*	2	2	small, calyx deeply 4-lobed	corolla sub-equally 5-lobed	2,adnate to corolla tube	12
3. *Gymnostachyum*	2	2	small, calyx 5-lobed	bilabiate/ corolla tube long	2	6 ovules / many ovules
4. *Phlogacanthus*	2	absent	calyx deeply 5-lobed, segments equal or subequal	corolla sub-equally 5-lobed, corolla tube ventricose, curved towards the throat/ straight	2	10-16
Subtribe Barleriinae						
5. *Barleria*	2/ absent	2/some species spinous	segments 4 2 outer large 2 inner small	sub-equally 5-lobed	4	4
6. *Chroesthes*	2	2	segment 5, sepals in opposite pairs, outer, interior and lateral	corolla 2-lipped, upper 2-lobed, lower 3-lobed	4, not connate at the base	2
7. *Lepidagathis*	2	2	calyx 5-lobed	bilabiate	2	6 / many ovules

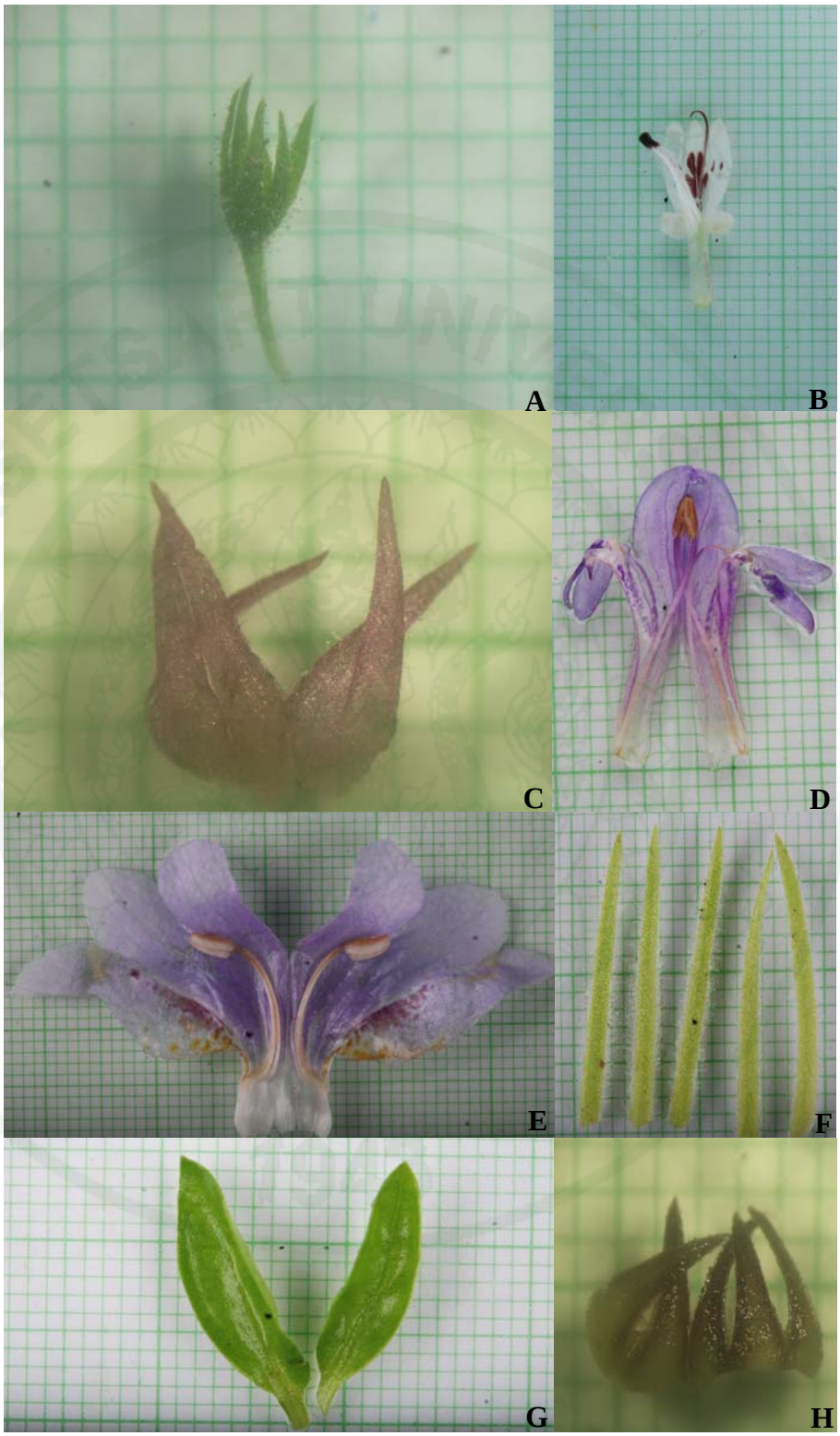

Figure 5 Floral Morphology of the subtribe Andrographinae: A-B: *Andrographis paniculata* (A=calyx), C-D: *Gymnostachyum leptostachyum* (C=calyx), E-F: *Phlogacanthus pedunculatus* (F=calyx), G-H: *P. pulcherrimus* (G=bract;H=calyx)

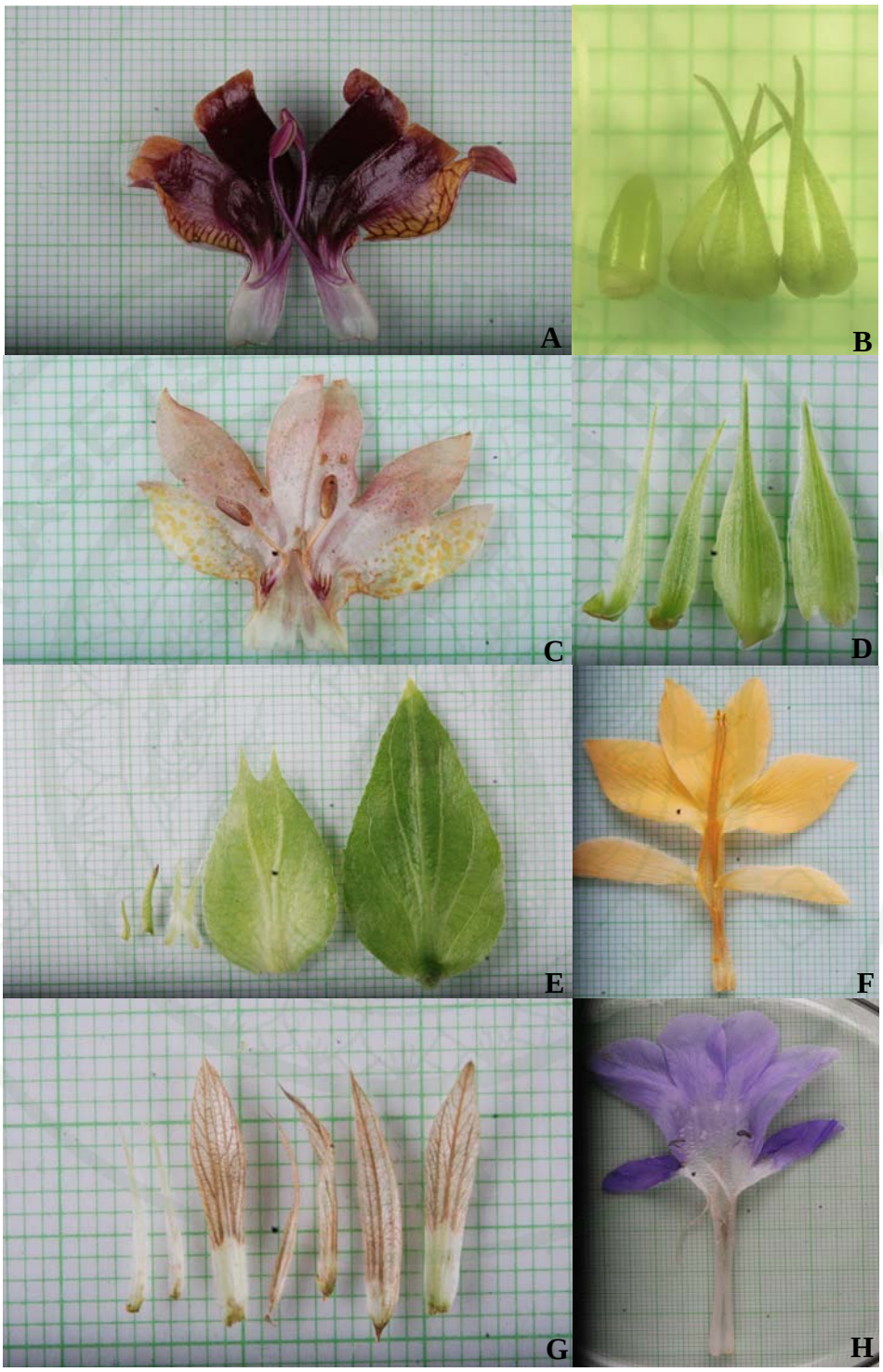

Figure 6 Floral Morphology of the subtribe Andrographinae and Barleriinae: subtribe Andrographinae A: *Phlogacanthus pulcherrimus*, B-C: *P. vitellinus* (B=calyx); subtribe Barleriinae D-F: *Barleria prionitis* (D=sepal; E=bracts And bracteoles), G-H: *B. siamensis* (G=sepal)

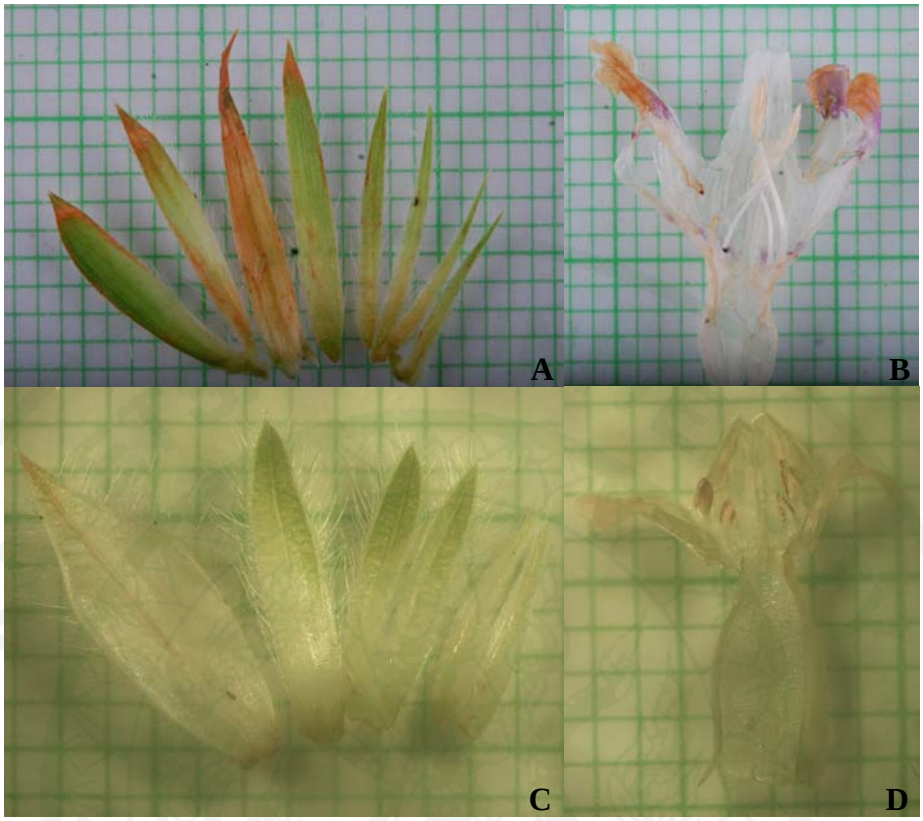

Figure 7 Floral Morphology of the subtribe Barleriinae:
A-B: *Lepidagathis falcata* (A=sepal and bract), C-D: *L. incurva* (C= sepal and bract)

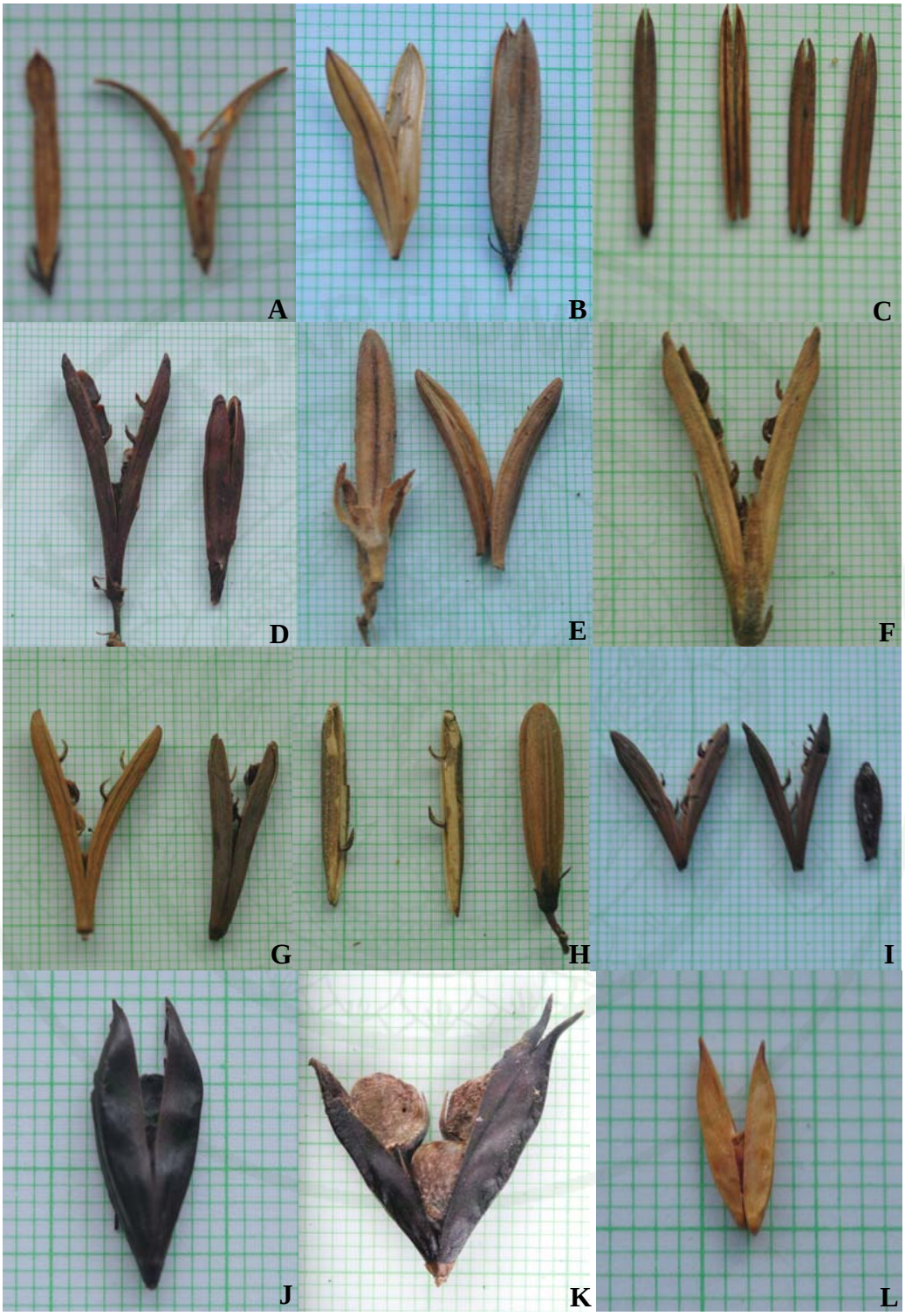

Figure 8 Fruit morphology of the subtribe Andrographinae: A. *Andrographis laxiflora*, B. *A. paniculata*, C. *Gymnostachyum canescens*, D. *Phlogacanthus curviflorus*, E. *P. paniculatus*, F. *P. pedunculatus*, G. *P. pulcherrimus*, H. *P. rectiflorus*, I. *P. vitellinus*; subtribe Barleriinae: J. *Barleria cristata*, K. *B. siamensis*, L. *Lepidagathis falcata*

2. Taxonomic Treatment

ACANTHACEAE JUSS.

Perennial herbs or shrubs, rarely trees; some are lianes, xerophytes, aquatic, or mesophytes. Leaves opposite or opposite and decussate, simple, estipulate; cystoliths are common on vegetative parts, such as leave blades, young shoots. Inflorescence usually developing into a monochasium or dichasial cyme, axillary and congested as the verticils, modified into racemoses or panicles, sometimes solitary. Flowers perfect, bisexual, nearly actinomorphic to zygomorphic, bracts with bracteoles common and often conspicuous, colored or even involucrate. Calyx deeply 4-5-lobed (include3- partites, two of which split into base, other one 3-lobbed; 2-partites, each of which 2-lobed and 3- lobed) or sometimes much reduced. Corolla sympetalous, with long or short tube, the limb 5-lobed or bilabiate, rarely 1-lipped (in *Acanthus*), upper lip usually erect and bifid, most typically 5-lobed, lobes contorted or imbricate in bud. Stamens usually 4 and didynamous or 2 (staminodia often present in 2-stamened flowers, 1-2 or seldom 3), epipetalous, distinct, sometimes connate in pairs, anthers 1- or 2- loculate, longitudinally dehiscent, exceedingly variable in position and form, sometimes spurred, the connective of various widths; the pollen very variable of many kinds mostly tricolporate. Nectariferous disk nearly always present, below ovary. Gynoecium of 2 united carpels; stigmas simple or 2- cleft or lobed, the posterior lobe often aborted or wanting, style filiforms, simple; ovary 2- loculate, superior, placentation axile; ovules 2-10 or more in each locule, anatropous, in 2 rows. Fruit typically a 2-valved loculicidal capsule, often elastically dehiscent with valves recurving from persistent cntral column (character of capsule and dehiscence varies with different genera). Seeds 4 (2) – 20, usullly flat, without endosperm (endosperm present in Nelsonieoideae), borne on hooklike projections, the modified funiculi of the ovules, termed retinacula or jaculators (lacking in *Thunbergia*, *Staurogyne*, *Ophiorhiziphyllon*, *Nelsonia*); seed coat smooth or roughened, often mucilaginous when moistened, embryo straight or bent.
Type genus: Acanthus L.

2.1 Subtribe Andrographinae

Herbs or shrubs erect, prostrate or procumbent. Leaves simple, opposite, entire, toothed, exstipulate, unarmed, usually entire, frequently conspicuously lineolate with cystoliths, petiolate or sessile. Inflorecence terminal and axillary; flowers hermaphrodite, in spikes, racemes, panicles or cymose, rarely solitary; bracts large or small, imbricated, persistent or caducous; bracteoles 2 or none, large or small or absent in *Andrographis* and *Phlogacanthus*. Calyx with 4 or 5 sepals, equal or unequal, free nearly to the base or connate but *Graphandra* calyx deeply 4 – lobed. Corolla gamopetalous, sub-equally 5-lobed, bilabiate (*Graphandra* and *Gymnostachyum*), or unilabiate; tube short or long, cylindrical, or ventricose or infundibuliform near the base; lobes imbricated or contorted in the bud. Stamens inserted on the coroola tube, 4 fertile didynamous or 2 fertile with or without 2 staminodes, included or exerted; filaments free or connate at the base in lateral pairs (*Graphandra*); anther dorsifixed, rarely basifixed, 1 or 2 locular. Ovary superior, bilocular; placentation axile; ovules 6-12 (*Andrographis*); 12 (*Graphandra*) 6–many (*Gymnostachyum*); 10-16 (*Phlogacanthus*) in each locule; style simple, filiform;

stigma subentire, minutely bifid or 2-lobed with one lobe obsolete or minute and denticulate. Capsule globose, oblong or linear, beaked or not, clavate, terete or compressed, seed bearing from the base or in the upper half only; placentae fixed or dehiscent, or springing elastically from the base and curving upwards with the seeds; dehiscence from the apex downwards, the valves recurving. Seeds 6-12 (*Andrographis*); 12 (*Graphandra*); 6 – many (*Gymnostachyum*); 10-16 (*Phlogacanthus*), globose, biconvex or flattened and discoid, smooth, scaly, verrucose, rugose, glabrous or hairy, the hairs often hygroscopic and springing out from the seed when moistened; jaculators often hard and curved funicular projections.

2.2 Subtribe Barleriinae

Herbs or shrubs erect, prostrate or procumbent. Leaves simple, opposite, entire, toothed, exstipulate, unarmed or spinescent (some species in *Barleria*), usually entire, frequently conspicuously lineolate with cystoliths, petiolate or sessile. Inflorecence terminal and axillary; flowers hermaphrodite, in spikes, racemes, panicles or cymose, rarely solitary; bracts large or small, imbricated, persistent or caduceus; bracteoles 2; large or small or absent (*Barleria*). Calyx with 4 or 5 sepals; segments 4, 2 outer large, 2 inner small (*Barleria*), segment 5, sepals in opposite pairs, bearing outer, interior and lateral ones (*Choresthes*) equal or unequal (*Lepidagathis*), free nearly to the base or connate. Corolla gamopetalous, sub-equally 5-lobed (*Barleria*), bilabiate (*Lepidagathis*); 2- lipped, upper 2-lobed, lower 3-lobed (*Chroesthes*); tube short or long, cylindrical, or ventricose or infundibuliform near the base; lobes imbricated or contorted in the bud. Stamens inserted or connate to the corolla tube (*Barleria* and *Lepidagathis*); not connate to the base (*Chroesthes*); 4 fertile didynamous or 2 fertile with or without 2 staminodes, included or exerted; filaments free or connate at the base in lateral pairs; anther dorsifixed, rarely basifixed, 1 or 2 locular. Ovary superior, bilocular; placentation axile; ovules 2 (*Chroesthes*); 4 (*Barleria*); 6-many (*Lepidagathis*) in each locule; style simple, filiform; stigma subentire, minutely bifid or 2-lobed with one lobe obsolete or minute and denticulate. Capsule globose, oblong or linear, beaked or not, clavate, terete or compressed, seed bearing from the base or in the upper half only; placentae fixed or dehiscent, or springing elastically from the base and curving upwards with the seeds; dehiscence from the apex downwards, the valves recurving. Seeds 2 or rarely (*Chroesthes*); 4 (*Barleria*); 6-many (*Lepidagathis*) to many, globose, biconvex or flattened and discoid, smooth, scaly, verrucose, rugose, glabrous or hairy, the hairs often hygroscopic and springing out from the seed when moistened; jaculators often hard and curved funicular projections.

About 17 genera from the tropical and subtropical regions in the old world. 7 genera are represented in Thailand.

Table 3 Enumeration of the subtribe Andrographinae and Barleriinae (Acanthaceae) in Thailand

Taxa	First publication	Type locality
Subtribe Andrographinae		
1. *Andrographis laxiflora* (Blume) Lindau	Nat. Pflanzenfam. [Engler & Prantl] iv. 3 b. (1895) 323.	Indonasia (Java)
2. *A. paniculata* (Burm.) Wall. ex Nees	Pl. Asiat. Rar. (Wallich). iii. 116.	India
3. *Graphandra procumbens* Imlay	Bull. Misc. Inform. Kew 1939, 127.	Thailand
4. *Gymnostachyum canescens* (Nees) T. Anders.	J. Linn. Soc., Bot. 9: 505. 1867.	India
5. *G. coriaceum* Imlay	Bull. Misc. Inform. Kew 1939, 128.	Thailand
6. *G. decurrens* Stapf	Bull. Misc. Inform. Kew (1894) 357.	Malaysia (Pa Hang)
7. *G. gracile* Bremek.	Dansk. Bot. Arv. xx. 77 (1961).	Thailand
8. *G. leptostachyum* Nees	Pl. Asiat. Rar. (Wallich). iii. 106.).	Myanmar
9. *G. signatum* (Benoist) Imlay	Bull. Misc. Inform. Kew 1939, 128.	Thailand
10. *G. trilobum* Ridl.	J. Fed. Malay States Mus. 10(4): 106. 1920.	Thailand
11. *G. venustum* (Wall.) T. Anders.	J. Linn. Soc., Bot. 9: 506. 1867 [23 Aug 1867]	Himalaya
12. *Pholgacanthus abbriviatus* (Craib) R. Ben.	Fl. Indo-Chine (P.H. Lecomte et al.) 4: 712. 1935.	Thailand
13. *P.asperulus* Nees	Pl. Asiat. Rar. (Wallich). iii. 99.	Himalaya
14. *P. brevis* C.B.Clarke	J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74: 665 (1907).	Malay Peninsular
15. *P. curviflorus* (Wall.) Nees	Pl. Asiat. Rar. (Wallich). iii. 99.	Himalaya
16. *P. murtonii* Craib	Bull. Misc. Inform. Kew 1911, 439.	Thailand
17. *P. paniculatus* (T. Anders.) J.B. Imlay	Bull. Misc. Inform. Kew 1939, 128.	
18. *P. pauciflorus* J.B. Imlay	Bull. Misc. Inform. Kew 1939, 129.	Thailand
19. *P.pedunculatus* J.B. Imlay	Bull. Misc. Inform. Kew 1939, 128.	Thailand
20. *P. pulcherrimus* T. Anders.	J. Linn. Soc., Bot. 9: 507. 1867.	-
21. *P. racemosus* Brem.	Dansk Bot. Ark. xx. 76 (1961).	Thailand

Table 3 (Continued)

Taxa	First publication	Type locality
Subtribe Andrographinae		
22. *Phlogacanthus rectiflorus* J.B. Imlay	Bull. Misc. Inform. Kew 1939, 130.	Thailand
23. *P. vitellinus* T. Anders.	J. Linn. Soc., Bot. 9: 507. 1867.	-
Sub tribe Barleriinae	Bull. Misc. Inform. Kew 1939, 124.	Thailand
24. *Barleria biloba* Imlay		
25. *B. cristata* L.	Sp. Pl. 2: 636. 1753 [1 May 1753]	India
26. *B. lupulina* Lindl.	Edwards's Bot. Reg. 18: t. 1483. 1832.	India
27. *B. prionitis* L.	Sp. Pl. 2: 636. 1753 [1 May 1753].	India
28. *B. siamensis* Craib	Bull. Misc. Inform. Kew 1911, 437.	Thailand
29. *B. strigosa* Willd.	Sp. Pl., ed. 4 [Willdenow] 3(1): 379. 1800.	India
30. *Chroethes bracteata* (J.B. Imlay) B. Hansen	Nordic J. Bot. 3(2): 210 (1983).	Thailand
31. *C. lanceolata* (T. Anders.) B. Hansen	Nordic J. Bot. 3(2): 209 (1983)	Myanmar
32. *Lepidagathis chiengmaiensis* Bremek.	Dansk Bot. Ark. xx. 72 (1961).	Thailand
33. *L. chlorostachya* Nees	Prodr. (DC.) 11: 256. (1847) [25 Nov 1847].	Myanmar
34. *L. dissimilis* Imlay	Bull. Misc. Inform. Kew 1939, 125.	Thailand
35. *L. falcata* Nees	Pl. Asiat. Rar. (Wallich). iii. 96.	Myanmar
36. *L. fasciculata* Nees	Pl. Asiat. Rar. (Wallich). iii. 95.	India
37. *L. incurva* Ham. ex D.Don	Pl. Asiat. Rar. (Wallich). iii. 95.	Tropical Asia
38. *L. purpuricaulis* Nees ex Wall.	Pl. Asiat. Rar. (Wallich). iii. 96.	Himalaya, Myanmar

Keys to Genera of Subtribe Baleriinae and Andrographinae (ACANTHACEAE)

1. Corolla lobes quinculcial, 5-lobed, infundibularis or salverform
   2. Calyx segments 4, opposite in pairs, 2 outer larger, cartilaginous spine – teethed at base, 2 inner very small, anther 2-celled **5. Barleria**
   2. Calyx segments 5, unequal, the antherior pair more or less connected; corolla 2-lipped
      3. Anther cells spurred, capsule large **6. Chroesthes**
      3. Anther cells not spurred, capsule small **7. Lepidagathis**
1. Corolla lobes imbricate, subequally 5-lobbed or distinct 2-lipped
   4. Calyx 4 free to the base **2. Graphandra**
   4. Calyx 5 deeply lobbed
      5. Sepal equal or unequal
         6. Anther base and filament villose **1. Andrographis**
         6. Anther base and filament glabrous **4. Phlogacanthus**
      5. Sepal subequal, the posterior smaller than the others **3. Gymnostachyum**

1. ANDROGRAPHIS

Wall., Pl. As. Rar. 3: 77. 1832.

Herbs or very small shrubs, erect or procumbent. Leaves opposite, simple, entire. Inflorescence axillary and terminal racemes, panicles, or dense, often 1-sided; bracts small; bracteoles 2 or absent. Calyx small, divided almost to the base into 5 sepals. Corolla small, obscurely or definitely bilabiate, with a short tubular base; lobes imbricated in the bud. Stamens 2, inderted near the mouth of the corolla tube; filaments ciliate or not; anthers included or exserted, bilocular, the cells equal or slightly unequal, parallel, muticous, bearded at the base; pollen "Daubenpollen" (Lindau) – grains ellipsoid, subglobose or obscurely trigonous, finely pitted, germ – pores 3 in short and broad grooves. Ovary bilocular, 6-12 ovulate; disc fleshy; style minutely bifid at the apex. Capsule linear or oblong-elliptic, compressed at right angles to the septum. Seeds subglobose, glabrous, pitted.

About 20 species from India, and tropical Asia. 2 species are found in Thailand.

Key to the species

1.Flowers in terminal lax and much-branched panicles; flowers solitary; corolla 2-lipped for half its length **1. A. paniculata**
1.Flowers in spikes, simple or branches; flower solitary or slustered; corolla obscurely 2-lipped **2. A. laxiflora**

1. Andrographis laxiflora Lindau**,** *In* Engl. et Prantl, Nat. Pfanzenfam. 4. 3b: 323. 1895.— *Haplanthus tener* Nees *In* Wall. Pl. As. Rar. 3: 116 (1832); Nees *In* DC. Prodr. 11: 512 (1847).— *Justicia tenuiflora* Wall. Pl. As. Rar. 3: 116 (1832) Ms. Nomen only; Wall Cat. 7185. —*Andrographis tenuiflora* T. Anders. In Journ. Linn.

Soc. 9: 502 (1367); C.B. Clarke in Hook. F. Fl. Brit. Ind. 4: 502 (1884); C.B. Clarke *In* Journ. As. Soc. Beng. 124: 666 (1908); Ridley Fl. Mal. Pen. 2: 582 (1923); R. Ben. *In* Léc. Fl. Gén. I.- C. 4: 698 (1935).— *Gymnostachyum parishii* T. Anders., *In* Journ. Linn. Soc. 9: 504 (1867).

Herb c. 60 cm high. Stems quadrangular, pubascent or glabrescent. **Leaves** subsessile or shortly petiolate, ovate, oblong or lanceolate, acute or acuminate to the apex, shortly attenuate or cuneate and sometimes rounded or obtuse at the base, minutely obscurely lineolate above, glabrescent or pubescent on the midrib and nerves, 3-12 cm long, 1-5.5 cm broad; midrib conspicuous above, prominent below; lateral nerves 5-7 pairs, conspicuous on both surfaces; petiole of the upper leaves almost 0.8 mm long or less. **Flower** simple or **Inflorescence** panicled, lax, sometime spikes of few-flowered clusters; flowers sessile or subsessile; bracts very small; bracteoles 0. **Calyx** glandular-pubescent, 2.5–3 mm long. **Corolla** white with mauve or purple markings, glandular puberulous or glabrous outside, c. 8 mm long; tube puberulous inside below the stamens and in the throat; limb obscurely bilabiate. **Stamens** inserted 3 mm from the base of the corolla; filaments broad at the base, narrowing to the apex, shortly pilose, c. 3 mm long; anthers included 1 mm long, ovoid, bearded. **Ovary** pubescent. **Capsule** c. 1.5 cm long, c. 2 mm broad, sparingly glandular-pubescent.

Thailand. —NORTHERN: Ching Mai (Ching Dao, Doi Saket, Doi Sutep), Lampang (Mae Mo), Nan, Kamphaeng Phet, Tak (Wang Chao).

Distribution. — India, Myanmar, China, Laos, Malay Peninsula, Indonesia.

Ecology. — In evergreen foret, near crest of ridge, c. 800 m, 1305 – 1315 m, In mixed jungle, 330 m In deciduous jungle, 150-360 m in dry mixed jungle, 200-300 m. In evergreen on bank of stream. In bamboo jungle, c. 200 m On limestone rocks, On open limestone ground, c. 100 m

Vernacular. — Ya Bang Phrai (หญ้าบังไพร).

Note. —In general,the flowers are singly arranged, rarely clustered.
A. laxiflora has a funnel-shaped, conspicuously curved and only shallowly 2-lipped corolla.

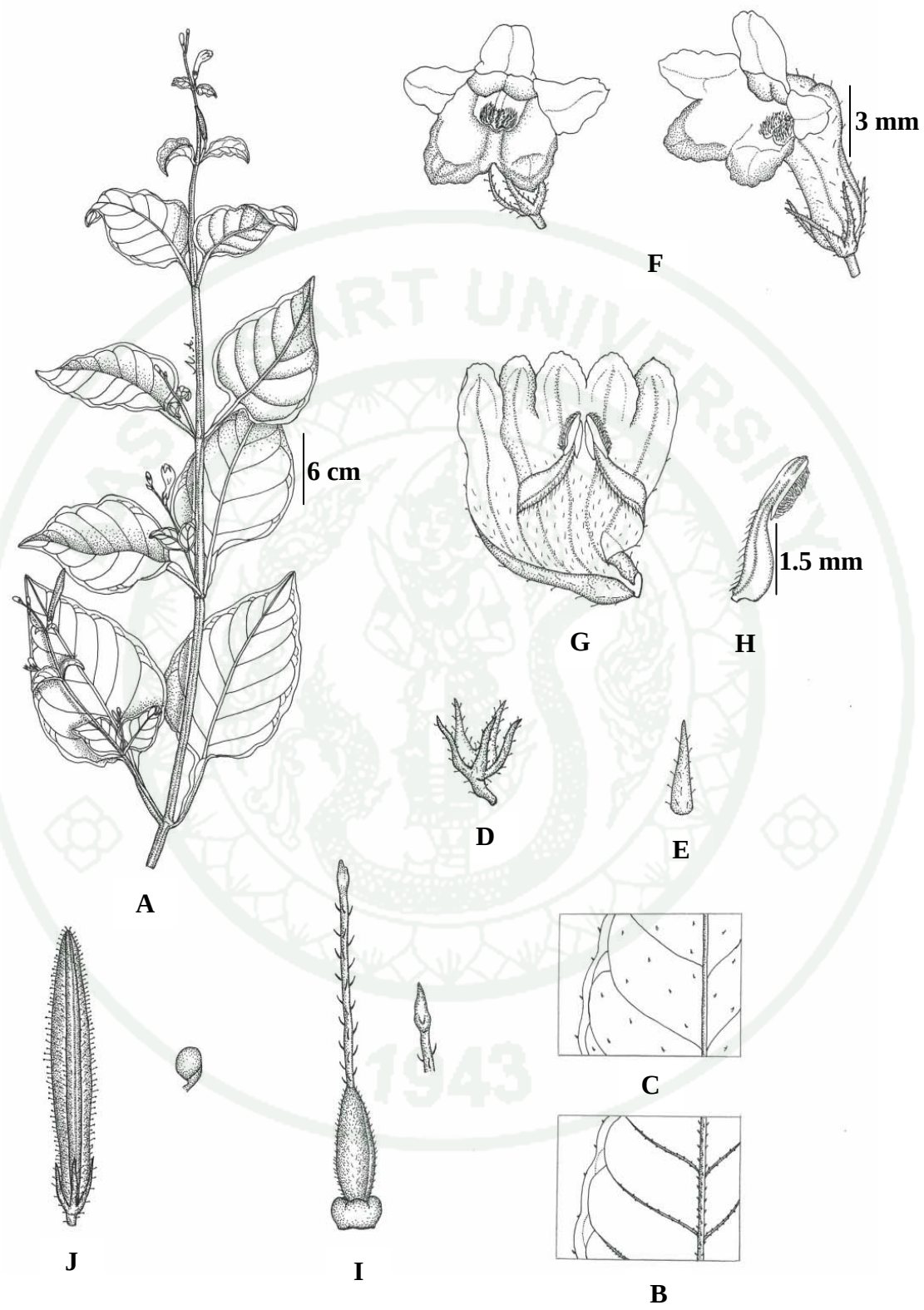

Figure 9 *Andrographis laxiflora*: A. habit; B. the abaxial of leaf; C. the adaxial of leaf; D. bract; E. calyx; F. flower; G. longtitudinal section of flower; H. stamen; I. pistil; J. fruit. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 014090208-5 (BK)

2. Andrographis paniculata (Burm.) Nees *In* Wall. Pl. As. Rar. 3: 116. 1832; Nees in DC. Prodr. 11: 515. 1847; Wight ic. T. 518 (1849); T. Anders. *In* Journ. Linn. Soc. 9: 502. 1867; C.B. Clarke in Hook. F. Fl. Brit. Ind. 4: 501. 1884; C.B. Clarke in Journ. As. Soc. Beng. 23: 665. 1908; R. Ben. *In* Léc. Fl. Gén. I.- C. 4: 698. 1935. ──*Justicia paniculata* Burn.f., Fl. Ind. 9. 1768; Blume Bijdr. 788 (1826); Wall. Cat. 2454.

Annual erect herb, 0.3-1 m high. Stems quadrangular, glabrous. **Leaves** ovate, oblong or lanceolate, narrowed and subacute at the apex, acute at the base, glabrous, 2-8 cm long, 1-3 broad; nerves conspicuous; margin entire; petiole 2-6 mm long, rarely 0. **Inflorescenc**e terminal, lax, of divaricate racemes; flowers solitary, distant, on pedicels 2-4 mm long and glandular-puberulous; bracts c. 1 mm long; bracteoles smaller or absent. **Calyx** c. 3 mm long long, glandular puberulous; sepals linear-lanceolate, free almost to the base. **Corolla** white spotted rose, pubescent outside, c. 1.2 cm long; tube as long as the limb. **Stamens** hairy towards the apex; anthers bearded at the base. **Ovary** very thinly hairy; style thinly hairy at the base. **Capsule** 1.6-1.8 cm long, c. 3 mm broad, slightly glandular-hairy when young, becoming glabrous.

Thailand. ── PENINSULAR: Songkhla (Muang; Hatyai; Sa Thing Phra), Phatthalung (Khuan Khanun), Trang (Khao Chong), Krabi (Muang).

Distribution. ── India to Assam, Ceylon, Malaysia Cochin China.

Ecology. ── Mostly in open area. In shaded hard wood forest. In rocky forest slopes. On limestone cliff. Cultivated.

Vernacular. ── Fa thalai (ฟ้าทะลาย), Fa thalai chon (ฟ้าทะลายโจร) (Bangkok), Yak an ngu (หญ้ากันงู) (Songkhla).

Uses. ──Medicinally used in protection snake bite by grounding leaves with alchoholic drink to decrease snake toxins.

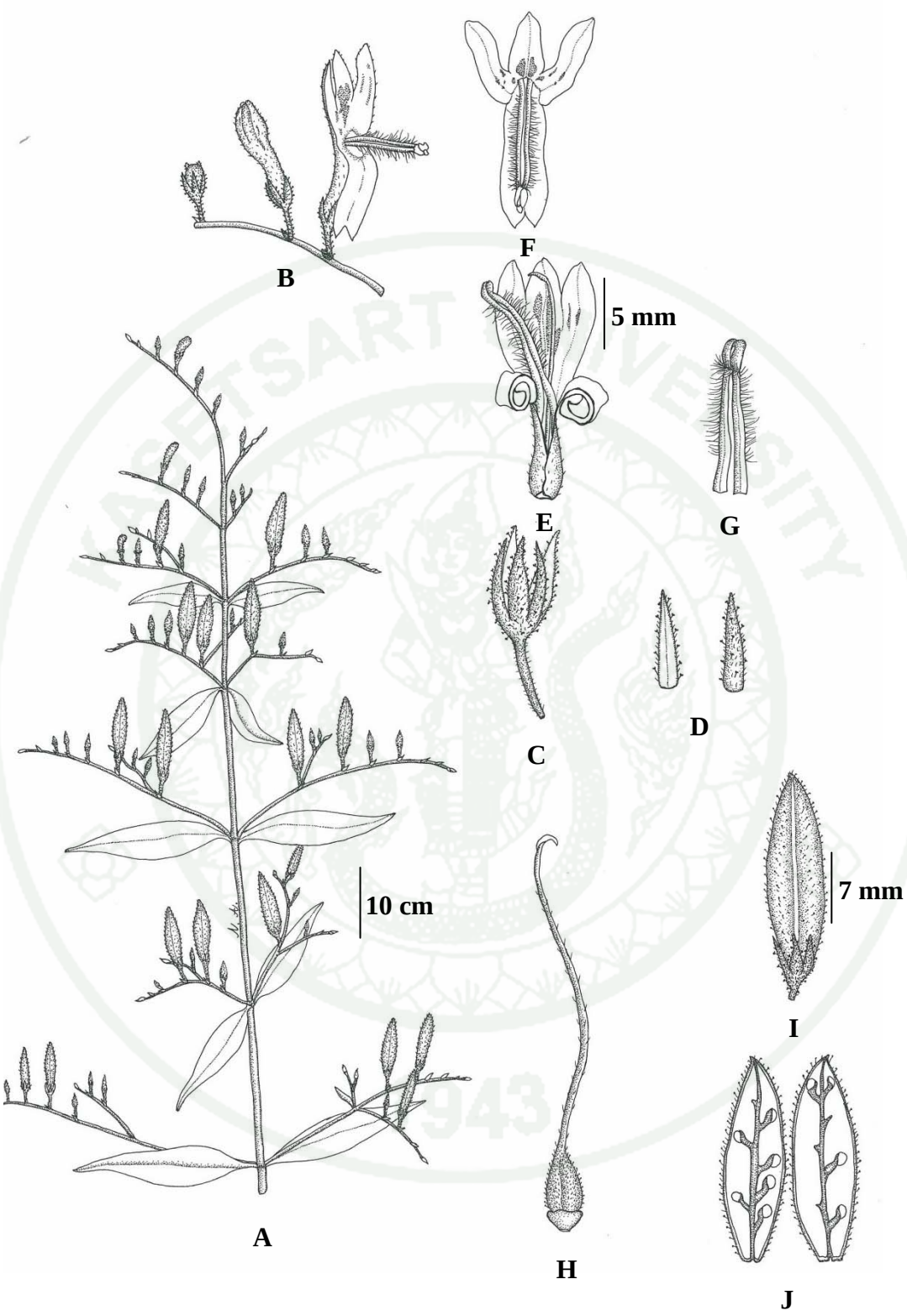

Figure 10 *Andrographis paniculata*: A. habit; B. flowering branch; C. bract; D. calyx; E. corolla limb revolute; F. stamen adpressed on corolla limb; G. stamen; H. pistil; I. fruit; J. seed arrangement. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 052160213-4 (BK)

2. GRAPHANDRA

J.B. Imlay, Bull. Misc. Inform. Kew.126. 1939.

Small herb, procumbent. Leaves opposite, small, entire, sessile or subsessile. Inflorescence terminal and axillary; small simple bracteates spikes; flowers alternate; bracts opposite, more or less imbricated, larger than the calyx; bracteoles equaling or a little longer than the calyx. Calyx of 4 sepals free to the base. Corolla tube almost as long as the limb; limb bilabiate, the upper lip narrow, slightly concave, entire or subentire, the lower lip oblong, 3-lobed; lobes imbricated in the bud. Stamens 2, affixed to the corolla tube by a thin membrane, free in the mouth of the tube; anther cells 2 equal, parallel, oblong, minutely mucronate at the base, hairy but not bearded at the base. Ovary bilocular, 12 – ovulate; style minutely bifid at the apex. Capsule oblong, scarcely compressed, not stalked, 12 – seeded from the base. Seeds flattened, smooth, almost glabrous.

Only one species found in Thailand. Endemic.

1. G. procumbens J.B. Imlay *In* Bull. Misc. Inform. Kew. 127. 1939.

Small, herbaceous, procumbent, much branched and spreading at the base. Stems slender, green, glabrous. **Leaves** sessile or subsessile, equal, very small, ovate-oblong, acute or subacute at the apex, acute at the base, subcoriaceous, almost Glabrous on both surfaces, 0.6 – 2.2 cm long, 4-8 mm broad; midrib and 3 pairs lateral nerves subobscure below; margin entire, rather thick, glabrous; petiole 0-2 mm long. **Inflorescence** terminal, and erect and axillary from the procumbent branches; flowers solitary, alternate in a simple bracteates spike; bracts more or less imbricated, opposite, one of each pair sterile, oblanceolate or oblong, acute at the apex,9- 10 mm long, 3-4 mm broad, glabrous, obscurely nerved; bracteoles a little longer than the calyx, oblong lanceolate, very shortly acuminate at the apex, c. 8 mm long, c. 2 mm broad, glabrous. **Calyx** 7 mm. long, minutely puberulous, the hairs gland-tipped towards the apex; sepals 4 free to the base, narrow lanceolate, long acuminate, margin sparingly and minutely ciliate, many of the hairs glandular. **Corolla** pale pink, puberulous outside, c. 1.3 cm long; tube narrow straight, hairy inside at the base, c. 6 mm long; upper lip narrow lanceolate, obtuse and subentire at the apex, slightly concave at the base, c. 6 mm long, c. 2 mm. broad; lower lip oblong, c. 7.5 mm long, 4 mm. broad, the lobes c. 2 mm long, obtuse, the median lobe twice as broad. **Stamens** 2, adnate to the corolla tube for c. 5 mm, then free; filamenta 1 mm. long, glabrous; anther calls parallel, oblong, very shortly mucronate at the base, c. 2 mm long, densely in the middle. **Ovary** sparingly hairy; style 8 mm long, sparingly hairy. **Capsule** c. 8 mm long, oblong, scarcely flattened except glabrous except minutely puberulous at the apex, 12-seeded. Seeds ovoid, flattened, smooth, with a few hairs.

Thailand. — NORTHEASTERN: Nakhon Phanom (Tha Uthen).

Distribution.— Endemic.

Ecology. — In open grassy ground, c. 200 m.

3. GYMNOSTACHYUM

Nees in Wall. Pl. As. Rar. 3: 76. 1832); Nees in DC., Prodr. 12: 97. 1847; Benth. & Hook.f., Gen. Pl. 1130. 1876. Type species: *Gymnostachyum leptostachyum* Nees.

Herbs or undershrubs, erect, often sub-acauline. **Leaves** cauline or almost radical, opposite, equal, entire or subentire. **Inflorescence** terminal and axillary, simple, branched or panicled. Flowers opposite or alternate, solitary, clustered or cymose, sessile or subsessile, forming simple spikes or terminal lax panicles, sometimes unilateral; bracts and 2 bracteoles very call. **Calyx** 5- lobed almost to the base; sepals subequal, the posterior sometimes smaller than the others. **Corolla** tube slender straight or slightly curved, narrow at the base then ridening slightly upwards; limb spreading, bilabiate; upper lip shortly 2-lobed or emarginated; lower lip shortly 3-lobed, the lobes imbricated in the bud. **Stamens** 2, inserted below the middle of the corolla tube; anthers included or sub-excert, bilocular; loculi oblong, muticous or very shortly mucronate at the base. **Ovary** bilocular, 8 – 30 – ovulate; disc conspicuous, rather fleshy; style minutely bifid at the apex. **Capsule** linear, terete or cotusely 4 – sided, seed – bearing from the base, each valve 3 – grooved seeds many, obliquely ovate, flattened, covered with hygroscopic bairs; ejaculators hard curved.

About 40 species from tropical Asia and Malaysia. 8 species are enumerated from Thailand.

Key to the Species

1. Flowers solitary, not fascicled or cymose:
   2. Posterior sepal smaller:
      3. Flowers opposite, the buds pointed **7. G. trilobum**
      3. Flowers alternate, the buds blunt **3. G. decurrens**
   2. Sepals all equal:
      4. Flowers not second; leaves with more than 6 pairs lateral nerves :
         5. Capsule glabrous **4. G. gracile**
         5. Capsule glandular-pubescent **6. G. signatum**
      4. Flowers second; leaves with 4-5 paira lateral nerve 3 **2. G. coriaceum**
1. Flowers fascicled or cymose :
   6. Terminal panicle small, spikiform, not apreading; Inflorescence glabrous; pedicels lengthening and the base of the calyx swelling in fruit **5. G. leptostachyum**
   6. Terminal panicle large, spreading
      7. Flowers in sessile fascicle, leaves mostly radical **8. G. venustum**
      7. Flowers in unilateral upward curving cymes; leaves cauline **1. G. canescens**

1. Gymnostachyum canescens (Nees) T. Anders. *In* Journ. Linn. Soc. 9: 505. (1867) C.B. Clarke *In* Hook.f., Fl. Brit. Ind. 4: 509 (1884). *Cryptophragmium canescens* Nees in Wall. Pl. As. Rar. 3: 100 (1832); Nees in DC. Prodr. 11: 95 (1847).

Justicia serrulata Heyne ex Wall. Cat. 2452. —*Cryptophragmium serrulatum* Nees *In* Wall. Pl. As. Rar. 3: 100. 1832; Nees *In* DC. Prodr. 11: 95. 1847; O. Kuntze Rev. Gen. 2: 483. 1891. —*Gymnostachyum serrulatum* T. Anders. *In* Journ. Linn. Soc. 9: 505. 1867.

Shrub 1.5 – 2.5 m high. Branchlets pubescent or villose, 4-angled. **Leaves** ovate or lanceolate, acuminate to the acute apex, attenuate at the base, lineolate and puberulous above, subtomentose on the nerves below, younger leaves sometimes covered with a yeloowish tomentum which persists longer on the nerves than on the lamina, 9-13 cm long, 4-6.5 cm long; midrib conspicuous above, prominent below; lateral nerves 12-14 pairs, prominulent below; margin subentire or minutely toothed, minutely ciliate; petiole 1.5 – 3.5 cm long, densely pubescent. **Inflorescence** panicled, axillary, becoming terminal, trichotomous, the lateral branches cymose curving upwards, 1-sided, with the flowers on the outer side, glandular-pubescent; pedicels 0-2 mm. long; bracts small, linear, c. 2 mm long; bracteoles minute. **Calyx** glandular hairy outside, c. 5 mm. long; sepals equal, free almost to the base, linear acute, almost glabrous inside. **Corolla** pale purple, glandular-pubescent outside, c. 1.4 cm long; tube widening from above the base, pubescent inside near the base; limb bilabiate. **Stamens** inserted c. 5 mm. from the base of the corolla, filaments c. 6 mm long. Glabrous; anthers linear, minutely mucronate at the base. **Ovary** glandular-pubescent; style hairy. Capsule 1.4 – 1.6 cm long, linear acute, glandular-hairy, 16 – seeded. Seeds ovoid, flattened, hairy, the hairs shortly spreading when wet.

Thailand. — NORTHERN: Chiang Mai (Chom Thong); SOUTHWESTERN: Kanchana Buri (Sai Yok); SOUTHEASTERN: Chon Buri (Siracha).

Distribution. — Thailand.

Ecology. — In mixed forest on limestone hill, c. 200 m, on marahy ground in evergreen forest.

2. Gymnostachyum coriaceum J.B. Imlay *In* Bull. Misc. Inform. Kew. 128. 1939.

Stems erect, 10 – 20 cm long, often branching near the base, densely pubescent, **Leaves** ovate, obtuse at the apex, rounded or shortly cuneate at the base, coriaceous, shining, glabrous above, pubescent below, 2.5 – 5 cm long, 1.5-3 cm broad; midrib and 4-5 pairs lateral nerves conspicuous on both surfaces; transverse nerves and nervules conspicuous; margin slightly recurved, glabrous, petiole 5 mm. long, tomentose. **Inflorescence** in spikes terminal and axillary, 2-3 together, dense, second, shortly peduncled, almost glabrous, 4-8 cm. long; flowers solitary; bracts lanceolate, acute, green, 3 – ribbed, horny, shorter than the calyx, c. 5 mm long, c. 1 mm broad, glabrous, ciliate, punctuate outside, one of each opposite pair barren; bracteoles 2, lanceolate – acuminate, c. 4 mm long, otherwise similar to the bracts. **Calyx** glabrous and punctuate outside, c. 6 mm long; sepals united at the base for c. 1.5 mm, linear-acuminate, 3-ribbed, with a small tuft of hairs at the base, margin shortly ciliate. **Corolla** glabrours outside, 7-8 mm long; tube as long as the limb, pubescent in the throat; upper lip subentire, or minutely 2-lobed; lower lip with 3

short rounded lobes. **Stamens** inserted near the apex of the corolla tube; filaments c. 1 mm. long, glabrous; anthers oblong, c. 2 mm long, slightly unequal, acute at the base. **Ovary** glabrous; style c. 4 mm. long, hairy. **Capsule** c. 1 cm long, glabrous, 9-10 seeded from the base.

Thailand. — NORTHEASTERN: Sakon Nakhon (Wanon Niwat).

Distribution. — Thailand.

Ecology. — In bamboo forest, c. 200 m.

3. Gymnostachyum decurrens Stapf *In* Kew Bull. 357. 1894; C. B. Clarke in Journ. As. Beng. Soc. Beng. 23: 661 (1908) ; Ridley Fl. Mal. Pen. 2: 579. 1923.
— *Gymnostachyum diversifolium* C. B. Clarke *In* Journ. As. Soc. Beng. 23: 662. 1908. Ridley Fl. Mal. Pen. 2: 579. 1932.

Herb, creeping at first, then erect. Stems short, up to 10 cm long, pubescent. **Leaves** ovate or oblong-ovate, rarely lanceolate, obtuse and sometimes rounded at the apex, suddenly narrowed at the base and decurrent on the petiole, one leaf at least rounded or subcordate at the base, sparingly lineolate and almost glabrous above, pubescent below particularly on the nerves, upto c. 12.5 cm, long, c. 5 cm broad; midrib conspicuous above, sub-prominent below; lateral nerves 6-7 pairs, conspicuous; margin subentire or undulate, petiole c. 3 cm long, pubescent. **Inflorescence** in terminal spike, simple or branched, near the base, erect, linear, glandular-pubescent, flowers solitary, alternate sub-sessile, the lowermost distant; bracts minute, linear; bracteoles minute. **Calyx** glandular-pubescent, 4-5 mm long; Sepals linear-lanceolate, acute, free almost to the base, the posterior sepal smaller. **Corolla** purple and wite or bluish purple, glandular-pubescent outside, 1.4-1.6 cm long; tube broadening towards the apex; limb bilabiate, the lobes oblong, rounded. **Stamen**s inserted about the middle of the corolla tube; filaments pubescent at the base; anther cells oblong, minutely mucronate at the base. **Ovary** minutely glandular-pubescent; style thinly hairy. **Capsule** 1.7-1.8 cm long, linear, glandular-puberulous, denser towards the apex, 20-seeded.

Thailand. — PENINSULAR: Surat Thani (Khantuli).

Distribution. — Malay Peninsular, Malaysia, Thailand.

Ecology. — Shaded, near the stream.

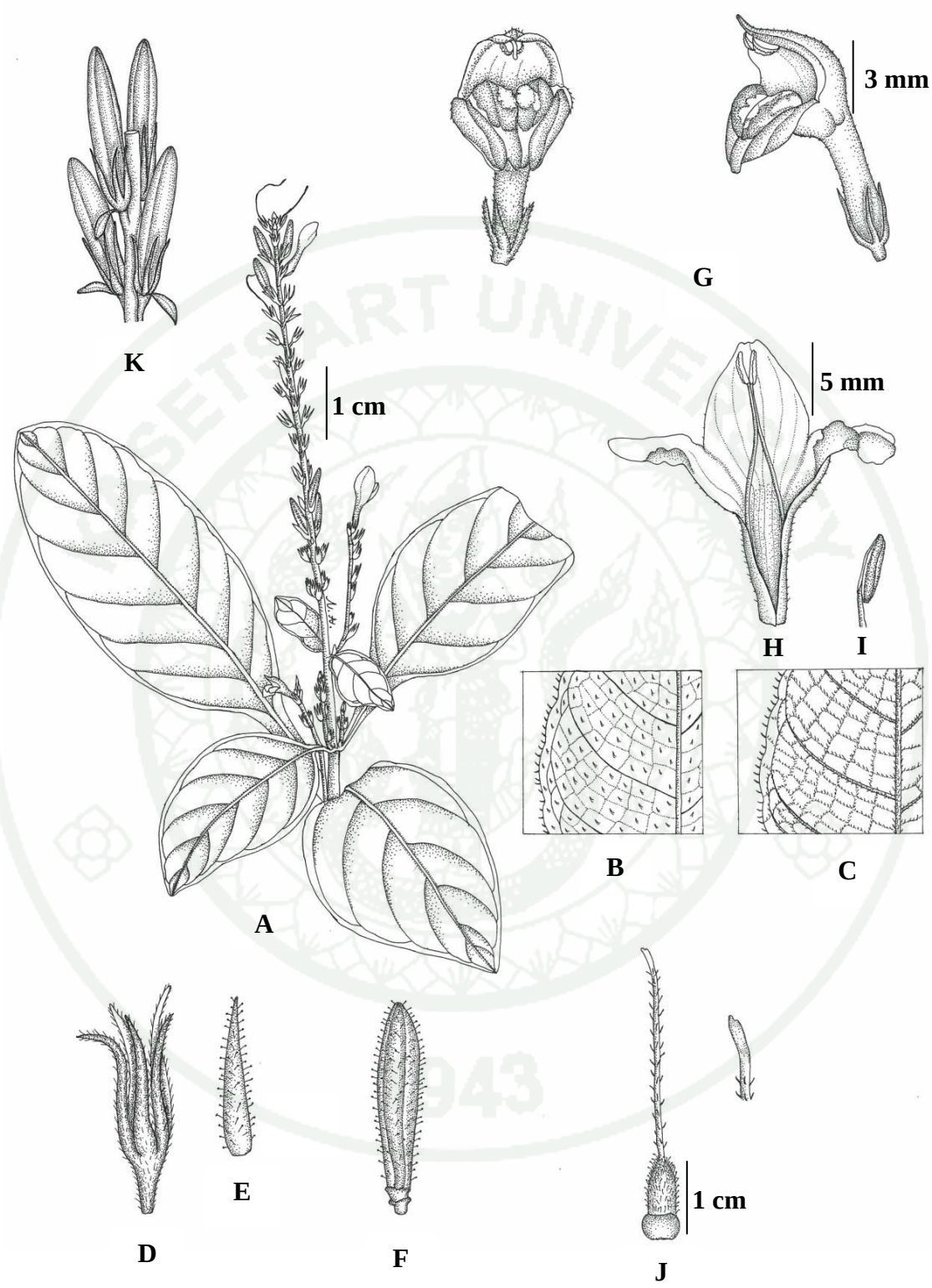

Figure 11 *Gymnostachyum decurrens*: A. habit; B. the abaxial of leaf; C. the adaxial of leaf; D. bract; E. bracteole; F. calyx; G. flower; H. longtitudinal section of flower; I. stamen; J. pistil; K. fruit. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 062280308-3 (BK)

4. Gymnostachyum gracile C. B. Clarke *In* Journ. As. Soc. Beng. 23: 662. 1908.

Top of stem leafy, c. 7.5 cm long. **Leaves** ovate, obtuse at the apex, attenuate at the base, glabrous above and below except the midrib and nerves, minutely pubescent below, 9.5-11cm long, 4.5-5.5 cm broad; midrib and 9-10 pairs lateral nerves con-spicuous on both surfaces; transverse nerves obscure; margin subentire; petiole 3-5 cm long, minutely pubescent. **Inflorescence** in terminal slender panicle with branches erect, 5-12 cm long; flowers distant, subsessile, solitary, sub-opposite or alternate; bracts minute, linear, c. l mm. long, puberulous. **Calyx** minutely puberulous, c. 3 mm long; sepals linear acute, free almost to the bass. **Corolla**, lower lip deep violet, upper lip white splashed with violet c. 1.2 cm long, pubescent outside; tube narrow, **Stamens** inserted about the middle of the corolla tube, broadening towards anthers in the mouth of the corolla tube, the cells equal, oblong, acute at the base. **Ovary** nearly glabrous; style thinly hairy towards the base. **Capsule** c. 1.2 cm long, linear-oblong, glabrate, 10-seeded.

Thailand. — PENINSULAR: Phathalung (Chong Forest Station).

Distribution. — Thailand.

Ecology. — Shaded, in evergereen forest, c. 200 m.

5. Gymnostachyum leptostachyum Nees *In* Wall. Pl. As. Rar. 3: 106. 1832; *In* DC.Prodr. 11: 93.

Stems erect or creeping, rooting, 7 – 10 cm high, branching near the base, densely pubescent. **Leaves** elliptic acuminate at both ends slightly pubescent, villous. **Leaves** 10-12 cm long, 4-5 cm broad, subentire, upper surface with distant multicellular lax hairs, lower pubescent on the nerves; petiole c. 1.5 cm **Inflorescence** in 1 or 2 terminal spike, 7-10 cm long, reduced to 1 or 2 long-linear spikes hairy; flowers solitary, distant ; bracts c. 1.5 cm, linear-lanceolate. **Sepals** in., linear-lanceolate, pubescent. **Corolla** narrow, straight, c. 1.7 cm **Capsule** c. 1.5 cm very slender, 20 seeded.

Thailand. —CENTRAL: Nakhon Nayok (Khao Yai); SOUTHWESTERN: Kanchana Buri, Phetchaburi (Kaeng Krachan); PENINSULAR: Trang, Nakhon Si Thammarat (Khiriwong); Ranong.

Distribution.— Myanmar.

Ecology. — Evergreen mountain forest, Limestone, 700-900 m.

6. Gymnostachyum signatum (R. Ben.) J. B. Imlay, ── *Cryptophragmium signatum*. R. Ben. *In* Bull. Soc. Bot. France. 602 (1934); *In* Léc. Gén. I. - C. 4: 700 .1935.

Herb. Stems 2-6 cm long, woody, densely pubescent. **Leaves** mostly radical, ovate to elliptic, obtusely triangular or rounded at the apex, suddenly narrowed and decurrent at the base, one or two upper leaves rounded or truncate at the base not decurrent, lineolate, sparingly setulose above, the hairs several – celled, midrib and nerves pubescent below 5-10 cm long, 2.5–5 cm broad; midrib conspicuous above, flattened and prominulent below; lateral nerves 6-9 pairs, conspicuous; margin entire, roughly ciliolate; petiole 1.5–2.5 cm long, flattened, pubescent the hairs several – celled. **Inflorescence** in terminal spike and axillary, often branched, 3-5 cm. long; flowers sublong, densely pubescent, many hairs glandular; flowers subsessile, solitary, dense; bracts linear, 1.5–2 mm long, pubescent; bracteoles similar but smaller. **Calyx** c. 4 mm long, glandular-pubescent outside; sepals linear, c. 3 mm long, pubescent inside, margin minutely glandular- ciliate. **Corolla** purple c. 1.5 cm long, minutely glandular-pubescent outside; tube twice as long as the limb, widening gradually upwards; upper lip emarginated at the apex; lower lip very shortly 3-lobed. **Stamens** inserted above the middle of the corolla tube; filaments c. 5.5 mm long, shortly hairy at the base; anthers narrow oblong, shortly mucronate at the base, exserted. **Ovary** pubescent towards the apex, 16-18 ovulate; style c. 1 cm long, hairy. **Capsule** c. 1 cm long, glandular pubescent, the pubescent, the hairs spreading. Seeds 16-18.

Thailand.──NORTHERN: Ching Mai (Mae Rim), Ching Rai (Mae Suai), Kamphaeng Phet; NORTHEASTERN: Phetchabun (Nam Nao), Loei CENTRAL: Saraburi (Samlan Forest; Muak Lek); EASTERN: Nakhon Ratchasima (Pak Chong); SOUTHEASTERN: Chon Buri (Ban Bung; Siracha); PENINSULAR: Chumphon.

Distribution. ── Laos.

Ecology.── In mixed deciduous forest, c. 400 m In evergreen forest.

7. Gymnostachyum trilobum Ridley in Journ. Fed. Mal. St. Mus. 10: 106. 1920.

Stem slender, creeping at the base, up to 20 cm long, puberulous. **Leaves** ovate or lanceolate, shortly acuminate to the subacute apex, cuneate or shortly attenuate at the base, glabrous and papillose above, puberulous on midrib and nerves below, usually 4.5-10 cm long, 2.5–5 cm long; midrib and 4-5 pairs lateral nerves conspicuous above and below, lateral nerves linked within the margin; margin subentire or obsucrly crenate; petiole 1.5-3 cm long, puberulous towards the base. **Inflorescence** in terminal spike, sometimes axillary, rarely divided, 5-17 cm long, shortly pedunculate; flowers opposite and decussate, buds acuminate; bracts lanceolate acuminate, 2.5–3 mm long, 1 mm. broad, margin scarious and minutely ciliate; bracteoles linear, c. 2.5 mm long, otherwise similar to the bracts. **Calyx** puberulous outside, c. 4.5 mm long; sepals free almost to the base, linear acute 3-ribbed, glabrous inside, margin minutely ciliate, the postertor segment much smaller, c. 1.5 mm long. **Corolla** white with purple markings, puberulous outside, c. 9 mm long; tube as long as the limb, pilose inside near the throat, upper lip erect, acute,

very shortly 2-lobed; lower lip degexed, deeply 3-lobed, the lobes c. 4 mm long, acuminate puberulous. **Stamens** inserted near the mouth of the corolla tube; filaments 2 mm long, puberulous at the base; anther cells subequal, minutely mucronate at the base. **Ovary** glabrous; style c. 4 mm long, puberulous. **Capsule** c. 1.3 cm long, glabrous, 8-seeded almost from the base.

Thailand. — SOUTHEASTERN: Sa Kaeo; PENINSULAR: Chumphon (Langsuan); Surat Thani (Khirirat Nikhom); Ranong (Kaper); Krabi (Nai Chong); Phangnga (Tap Put); Phatthalung (Sibanphot); Trang (Huai Yot).

Distribution. — Myanmar.

Ecology. — In scrub, c. 50 m By stream in evergreen forest, c. 100 m In bamboo forest, c. 50–500 m.

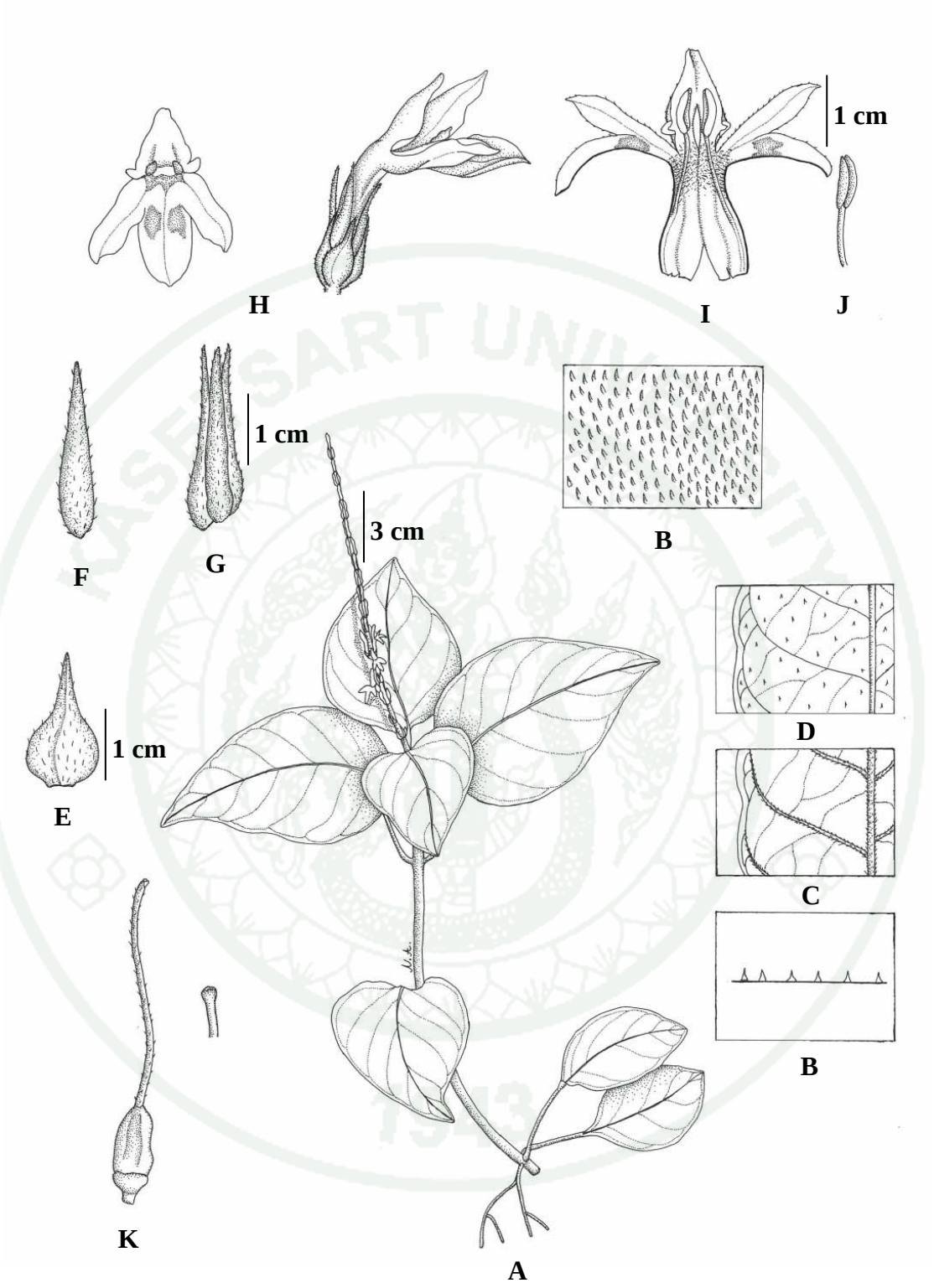

Figure 12 *Gymnostachyum trilobum*: A. habit; B. hair on the adaxial leaf surface; C. the abaxial of leaf; D. the adaxial of leaf; E. bract; F. bracteole; G. sepal; H. flower; I. longtitudinal section of flower; J. stamen; K. pistil. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 013040108-2 (BK)

8. Gymnostachyum venustum (Wall.) T. Anders. in Journ. Linn. Soc. 9: 506 1867; C.B. Clarke in Hook. f., Fl. Brit. Ind. 4: 507. 1884. —*Justicia venusta* Wall. Pl. As. Rar. 20: 153, t. 66. 1830; Wall. Cat. 2740 A,B; Bot. Reg. t. 1380 . 1831. — *Cryptophragmium venustum* Nees in Wall. Pl. As. Rar. 3: 100. 1832; Bot. Mag. T. 3208. 1833; Nees in DC. Prodr. 11: 94. 1847.

Stem very short. **Leaves** mostly radical, large, ovate to elliptic, acute at he apex, decurrent at the base on the petiole, chartaceous, younger leaves densely white-tomentose from the base, mature leaves becoming glabrous on both surfaces, 16-24 cm long, 7.5–11 cm broad; midrib conspicuous, slightly sunken above, flattened below; lateral nerves 13-14 pairs, the lowermost transverse and closer together; marfin entire, minutely ciliate; petiole c. 6 cm long, densely pubescent. **Inflorescence** in axillary spike, long-pedunculate, simple or in a loose panicle; peduncles often 17 cm long, obtusely quadrangular, densely pubescent, the hairs white and several-celled; flowers opposite, sessile, distant, 1-5 together; bracts very small, linear; bracteoles minute. **Calyx** c. 4 mm long, green tinged purple, glandular-pubescent outside; sepals equal, linear acute, free almost from the base, margin shortly glandular ciliate. **Corolla** purple, glandular-pubescent outside, c. 1.6 cm long; tube much longer than the limb, slender, broadening upwards; upper lip shortly 2-lobed, the lower 3-lobed; lobes patulous, obtuse, 2.5–3 mm long, the median lobe shorter and broader. **Stamens** inserted in the middle of the corolla; filaments c. 6.5 mm long, glabrous; anthers exserted, oblong, minutely mucronate at the base. **Ovary** pubescent towards the apex; style c. 1.4 cm long, glabrous. **Capsule** c. 1.2 cm long, shortly glandular-pubescent, 20seeded.

Thailand. —SOUTHWESTERN: Kanchana Buri (Wang Ka).

Distribution. — Himalaya.

Ecology. — On limestone rocks in evergreen forest, c. 200 m.

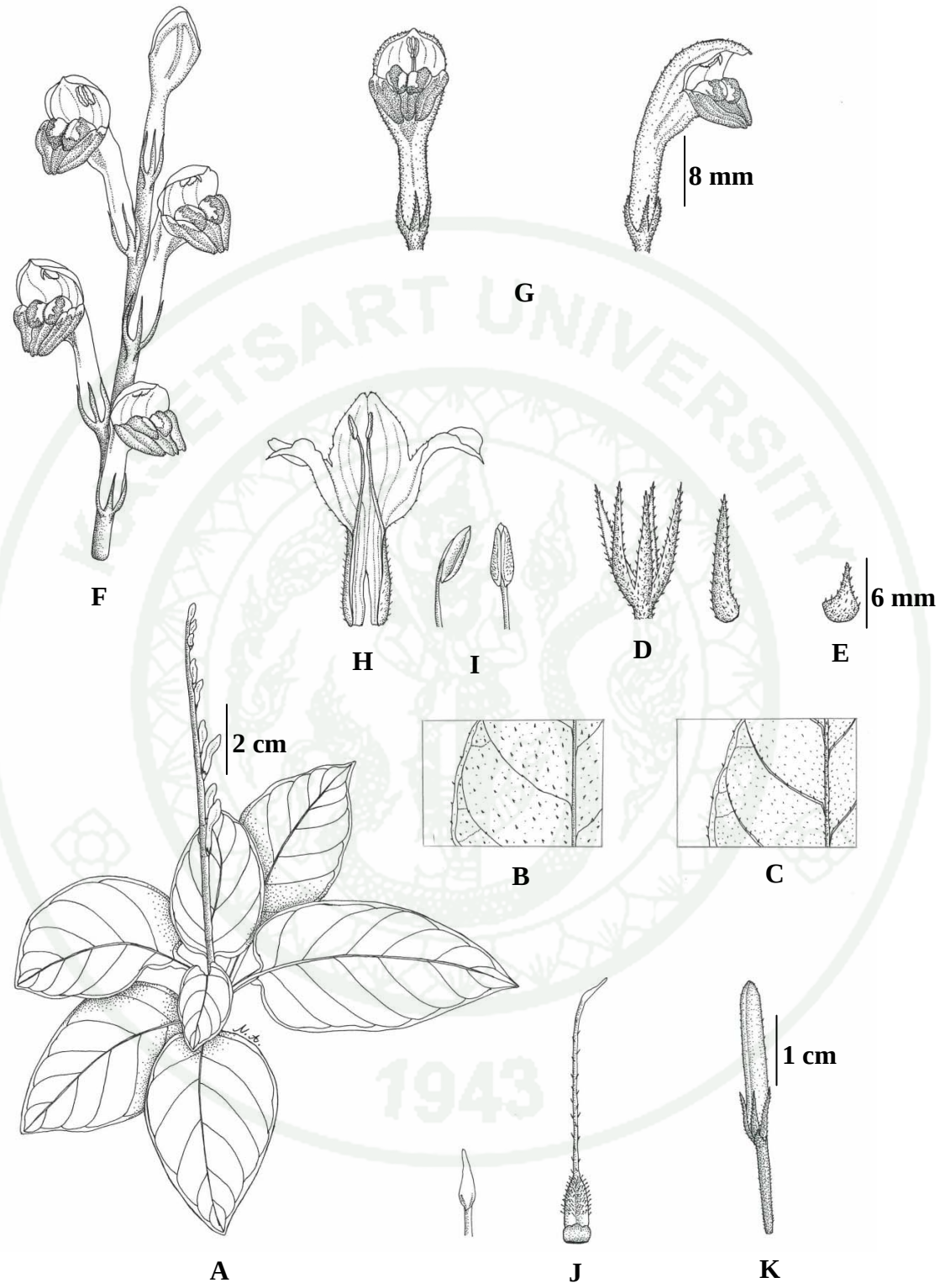

Figure 13 *Gymnostachyum venustum*: A. habit; B. the abaxial of leaf; C. the adaxial of leaf; D. bract; E. bracteole; F. inflorescence; G. flower; H. longtitudinal section of flower; I. stamen; J. pistil; K. fruit. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 051280908-5 (BK)

7 PHLOGACANTHUS

Nees *In* Vall. Pl. As. Rar. 3: 76, 99. 1832. Loxanthus Nees *In* Wall. Pl. As. Rar. 3: 76, 322. 1832. Janasia Rafin. Fl. Tellur. 4: 63. 1836. *Cystacanthus* T. Anders. *In* Journ. Linn. Soc. 9: 457. 1867. *Meninia* Fua ex Hook. f. Bot. Mag. t. 6043. 1873.

Herbs or shrubs, erect, rarely prostrate or straggling. **Leaves** entire or obscurely crenulate. **Inflorescence** terminal and axillary, simple, or narrow spikiform panicles; bracts small; bracteoles foliaceous, lanceolate or linear. Calyx deeply 5-lobed; sepals equal or subequal. **Corolla** tube cylindrical at the base becoming ventricose, more or less curved towards the throat or straight; limb spreading, sub-equally shortly 5-lobed, or sub – bilabiate, the 2 posterior lobes a little longer and more united at the base to form a more or less distinct upper lip; lobes rounded, imbricated in the bud. **Stamens** 2 perfect, with or without 2 small staminodes, inserted near the middle of the corolla tube; filaments included, of ten dilated at the base; anther cells 2, oblong, equal. **Ovary** bilocular, at least 8-ovulate; disc thick, fleshy, scarcely prominent; style minutely 2 - toothed at the apex. **Capsule** linear, terete, or obtusely 4-sided, scarcely contracted at the base, seed-orbiculate, compressed, hygroscopically hairy or glabrous, borne on hard pointed jaculators.

About 20 species from tropical India and Indo-China. 12 species are enumerated from Thailand.

Key to the species

1. Two minute rudiments at the base of the fertile stamens; seeds 8-10
   2. Flowers in narrow terminal panicles:
      3. Corolla tube, short, thick, curved, less than 0.5 cm. long,
         4. Pedicel 3 cm., leaves ovate, blunt narrow, decurrent on the base **3. P. brevis**
         4. Pedicel less than 3 cm., leaves oblanceolate or obovate, base angustate **1. P. abbreviatus**
      3. Corolla tube, short, not thick, curved or not curved, more than 1 cm. long
         5. Capsule 8 – seeded, Corolla tube, short
            6. Corolla tube not curved **11. P. rectiflorus**
            6. Corolla tube curved
               7. Flower white, pubescent, corolla tube inflated **2. P. asperulus**
               7. Flower pinkish-red, yellow spotted in throat, glabrous, corolla tube not inflated **12. P. vitellinus**
         5. Capsule 10 – seeded, Corolla tube, long **4. P. curviflorus**
   2. Flowers in short simple axillary racemes **5. P. murtonii**
1. Two fertile stamens without rudiments; seeds 12:
   8.Flowers in panicles, dense and thyrsoid, or more lax with pedunculate cymose branches:
      9. Calyx at most 5 mm. long; flower buds white tomentose at the apex; panicle dense thrysoid **9. P. pulcherrimus**
      9. Calyx at least 7mm. long; buds glandular-pubescent throughout; panicles fairly lax with pedunculate cymose branches:

10. Calyx erect or deflexed in fruit, more than 1 cm. long, petiole up to 2 cm. long, sepals. 5 mm. broad **6. P. paniculatus**
10. Calyx erect. in fruit not deflexed, at least 1 cm. long, petiole at most 4.5 cm. long sepals 2 mm. broad

8. Flowers in simple racemes or panicles
11. Corolla glandular pubescent, ventricose, leave oblong to ovate-lanceolate
12. Inflorescence in simple racemes **7. P. pauciflorus**
12. Inflorescence in terminal and lateral panicle **8. P. pedunculatus**
11. Corolla glabrous, not ventricoe, leave elliptical **10. P. racemosus**

1. Phlogacanthus abbreviatus (Craib) R.Ben. *In* H.Léc., Fl.Gén.I.- C. 4:712. 1935.
— *Cystacanthus abbreviatus* Craib *In* Kew Bull. 438. 1911.

Small shrubs, up to 1 m high, stoniferous. Young branches terete, green slightly hairy, then quadrangular, stramineous, slightly scabrous. **Leaves** oblanceolate or obovate-lanceolate, apexshortly acuminate, obtuse, base angustate, c. 15 cm long, c. 5 cm broad, papyraceus, entire, glabrous adaxial, slightly hairy on the veins adaxil, usually lateral viens 6, minutely convex adaxial, with the transversal veins convex abaxial, petioles c. 3.5 cm long. **Inflorescence** in narrow panicle terminal, erect, abbreviated. Bracts minute, caducous, Pedicels c. 3 mm long. **Caylx** segments linear-lanceolate, nearly obtuse, c. 0.7 cm long, c. 0.15 cm. broad, appressed strigosus outside, loosely capitate-glandular ciliate. **Corolla** purple.

Thailand. —NORTHERN: Nan (Hue Pa).

Distribution. —Thailand.

Ecology. — Mixed forest by stream, c. 300 m.

Note. — According to the original description and the photo of type specimens, this species differs from *Phlogacanthus asperulus* Nees, chiefly the panicly abbreviated very much. Leaves rather small, 15 x 5 cm, lateral viens 6 pairs, from the photo, the flowers are similar to the later. The so-called panicle means many cymes opposite on inflorescence axis, all these types of inflorescence in this genus are just same, if the pedicels of cymes are very short or none, it would be spike; if the pedicels of cymes specially peduncles very long. It would be panicle. It would by probably better after further study in detail and the observation of type specimen. Indumentums similar to *Phlogacanthus paniculatus* except loosely hairy abaxial.

2. **Phlogacanthus asperulus** Nees, Pl. As. Rar. (Wallich). 3: 99. 1832.

Shrub 0.3 – 1 m high, branched. Branchlets sharply 4 –angled when young, becoming obtusely quadrangular, sparingly puberulous upwards or almost glabrous. **Leaves** petiolate, broadly elliptic, some lanceolate, shortly acuminate to the acute apex. Tapering to acute at the base, glabrous except the nerves minutely puberulous

below, 7-17.5 cm long, 3-8 cm broad; midrib conspicuous above, prominent below; lateral nerves 6-8 pairs, conspicuous above, prominent below; margin subentire, glabrous; petiole 1-1.5 cm long, glabrous. **Inflorescence** a narrow terminal panicle, 2-6 cm long, c.1-2 cm broad; upper flowers solitary, opposite, the lower flowers in small shortly peduncled cymes; pedicels c. 3 mm long or less; peduncles and pedicels shortly pubescent; bracts at the base of the pedicel, lanceolate, acuminate, shortly pubescent, 3-4 mm long; bracteoles c. 1.5 mm long, linear, shortly pubescent, affixed about the middle of pedicel. **Calyx** shortly pubescent outside, 4.5-5 mm long; sepals lanceolate, acuminate, united at the base for c.1.25 mm, shortly pubescent inside towards the apex, minutely ciliate, 3-nerved. **Corolla** white, glabrous, 0.8-1.2 cm long; tube narrow at the base, then suddenly curved and inflated, glabrous inside except for an incomplete ring of short hairs near the throat; limb shortly obscurely bilabiate; lobes 3-5 mm long, ovate or ovate-oblong, acute, puberulous inside towards the margin. **Stamens** 2 fertile and 2 minute rudiments inserted c. 5 mm from the base of the corolla; filaments c. 6 mm long, curved, shortly hairy at the base; anthers exserted, oblong, c. 2.5 mm long, glandular hair at the back. **Ovary** glabrous. 8-ovulate; style c. 9 mm long, glabrous. **Capsule** c. 1.7 cm long, glabrous, 8-seeded from the base.

Thailand.—NORTHERN: Lampang (Muang Pan).

Distribution. —Himalaya.

Ecology.—On shady moist bank of stream, c. 350 m.

Vernacular.— Phraya Rak Luang (พญารากเหลือง) (Lampang).

Note.— All the collections from Thailand, except Kerr 1053, show leaves much larger than in any of the Indian plants.

3. **Phlogacanthus brevis** C.B. Clarke *In* Wall. Pl. As. Rar. 3: 99. 1832.

Undershrub, up to 45 cm high. **Leaves** ovate blunt narrowed and decurrent on petiole, 8-10 cm in, long, 7-8 cm broad ; petioles 2-4 cm long. **Inflorscence** in panicle 5-10 cm long. Dense with short branches. Sepals 4-5 cm long, pubescent. **Corolla** thick tube short, curved, c. 0.5 cm long and as wide, pubescent. Stamens 2, anther cell oblong, parallel. **Capsule** narrowly ellipsoid contracted to the base, c. 2.5 cm long, nearly c. 0.5 cm broad, sub-cylindric blunt narrowed at base, 8-seeded.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Lansaka); Narathiwat (Waeng).

Distribution. — Malay Peninsular.

Ecology. — In evergreen forest, c. 100 m.

4. Phlogacanthus curviflorus (Wall.) Nees *In* Wall. Pl. As. Rar. 3: 99. 1832; Bot. Mag. T. 3783. 1840; Nees in Dc. Prodr. 11: 320. 1847; T. Anders. *In* Journ. Linn. Soc. ix 506. 1867; C. B. Clark in Hook. F. Fl. Brit . Ind. 4: 511. 1884; Hosseus in Engl. Bot. Jahrb. 11: 69. 1908; R. Ben. *In* Léc. Fl. Gén. I.- C. 4: 709. 1935.
— *Justicia curviflora* Wall. Pl. As. Rar. 2: 9, t. 122. 1831.

Shrub up to 3 m high. Branchlets terete, stout, glabrous drying black. **Leaves** large, petiolate, elliptic or obovate-elliptic, rarely oblong or lanceolate, acuminate at both ends, acute at the apex, glabrous, 20-50 cm. long, 10-22 cm broad; midrib prominulent and often puberulous above, prominent below; lateral nerves 13-14 pairs, conspicuous above, sub-prominent below; lineolate; margin subentire, glabrous; petiole 6-10 cm long, almost glabrous. **Inflorescence** a narrow terminal panicle, 10-18 cm long, fairly densely and very shortly villous; flowers in small opposite biparous cymes, each very shortly pedunculate; bracts small, linear acute, 4-6 mm long, minutely ciliate; pedicels 10-12 mm long, puberulous, or almost glabrous, with 2 small, linear opposite bracteoles 2-3 mm long near the base. **Calyx** almost glabrous outside, sepals 5, equal, linear-acuminate, 6-7 mm long, united at the base for c. 2 mm, densely hairy inside, the hairs appressed upwards, margin minutely ciliate. **Corolla** red, shortly densely villous outside with several hairs gland-tipped, 5.5-6 cm long; tube narrow, curved, widening very gradually from the base, glabrous inside at the base, becoming hairy upwards; limb bilabiate; upper lip c. 11 mm long; 2-lobed for almost half its length; lower lip c. 9 mm long, 3-lobed almost to the base; lobes oblong, acute, densely tomentose inside. **Stamens** 2 fertile, and 2 very small rudiments, inserted c. 10 mm from the base of the corolla; filaments c. 4.5 cm long, glabrous except for a few hairs at the base; anthers exserted, linear, 5.5-6 mm long. **Ovary** glabrous, 10-ovulate; style c. 5.5 cm long, hairy towards the apex. **Capsule** 4.5-5 cm long, glabrous.

Thailand.— NORTHERN: Ching Mai (Chiang Dao), Ching Rai (Mae Lao; Mae Suai; Wiang Papao), Phrae, Nan (Doi Phu Kha), Tak (Mae Sot).

Distribution.—Himalaya, Northeastern India, South China, Thailand, Vietnam.

Ecology. —On marshy ground in evergreen forest, c. 900 m By stream 700-1100 m.

Vernacular. — Hom Chang (ห้อมช้าง) (Chiang Mai)

Uses. —Whole plant grind to be applied for curing swell, pain, liver disease, Root pounded and mixed with alcohol to be applied for bone crack rehabilitation. Root boiled with chicken to cure stomachache.

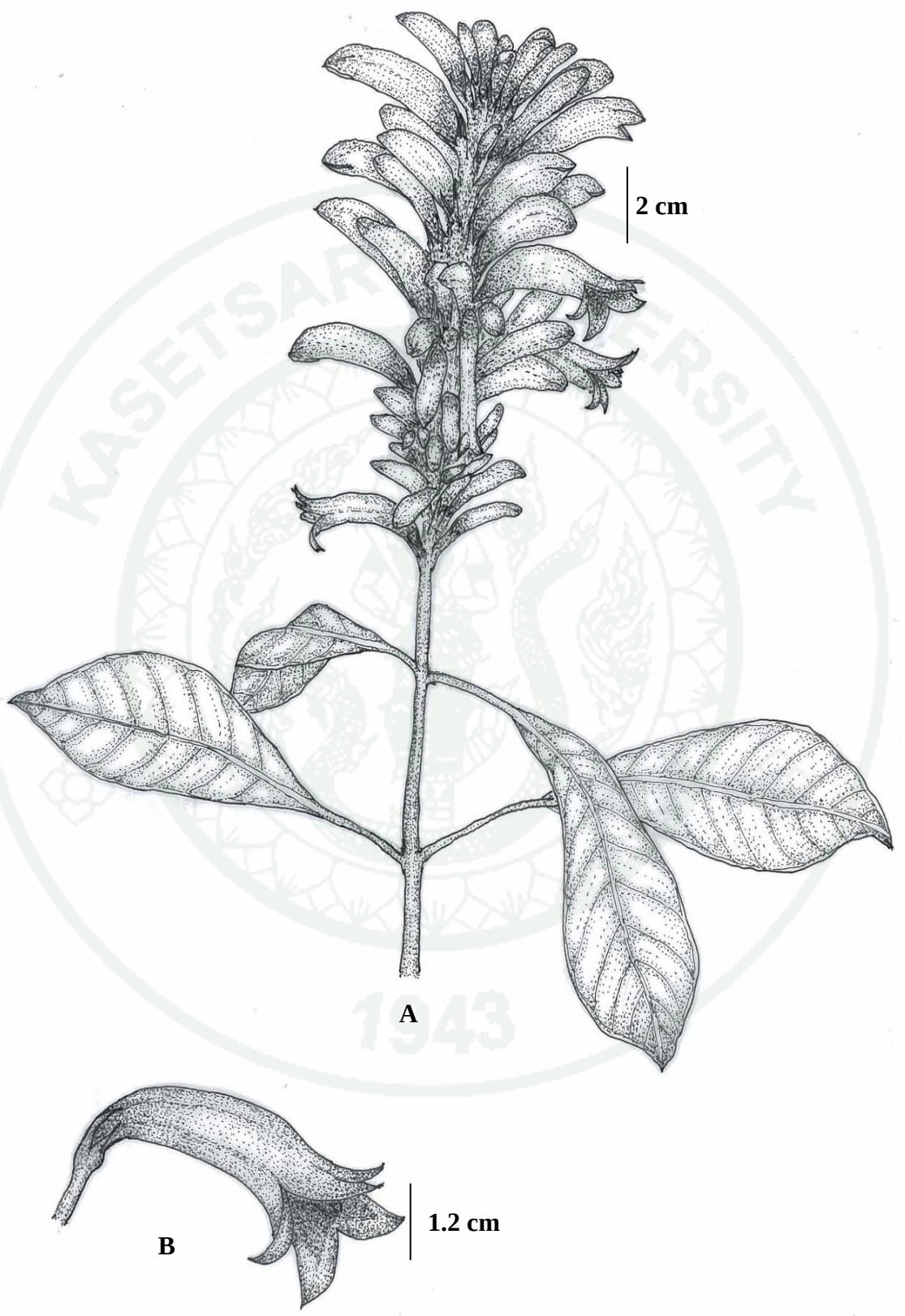

Figure 14 *Phlogacanthus curviflorus*: A. flowering branch; B. flower. Drawn by Jessada Tengrang. All from Winai Somprasong 052080112-10 (BK)

5. Phlogacanthus murtonii Craib *In* Kew Bull. 439. 1911.

Shrub c. 4 m high. Stems stout, terete, glabrous, with a light coloured wrinkled bark. **Leaves** in equal pairs, oblanceolate, acuminate to the acute apex, unequal-sided and attenuate on the petiole at the base, glabrous on both surfaces, 9-28 cm long, 2.7-8.5 cm broad, chartaceous; midrib conspicuous above, prominent below; lateral nerves 8-9 pairs ascending, conspicuous above, prominulent below; transverse nerves sub-obscure; margin entire or subentire; petiole 1-5 cm long. **Inflorescence** small, racemose, axillary, opposite, glabrous; bracteoles minute, affixed below the middle of the pedicel; pedicel up to 8 mm. long. **Calyx** c. 3 mm long; sepals linear-lanceolate, acute, free almost to the base, glabrous. **Corolla** red, glabrous outside, c. 2.2 cm long; tube 1.5 cm long, slightly curved upwards, glabrous inside; limb sub-bilabiate, the lobes minutely and densely papillose inside. **Stamens** 2 fertile, and 2 minute rudiments, inserted above the middle of the corolla tube; filaments c. 1.4 cm long, glabrous or with a very few hairs at the base; anthers exserted, oblong, c. 2.5 mm long. **Ovary** glabrous; style glabrous. **Capsule** c. 3 cm long, glabrous, 12-seeded from the base.

Thailand.—SUTHEASTERN: Chanthaburi (Pong Nam Ron; Khao Soi Dao; Khao Sabap).

Distribution.—Thailand.

Ecology.—In evergreen forest, c.50 m.

6. Phlogacanthus paniculatus (T. Anders.) J. B. Imlay *In* Bull. Misc. Inform. Kew. 129. 1939.— *Cystacanthus paniculatus* T. Anders. *In* Journ. Linn. Soc. 9: 458. 1867; C. B. Clarke in Hook. f. Fl. Brit. Ind. 4: 514. 1884.

Shrub up to 3 m high. Branchlets quadrangular, subalate, glabrous, stout. **Leaves** elliptic or lanceolate, acuminate to the acute apex, attenuate at the base and shortly decurrent along the petiole, chartaceous, lineolate, glabrous above, puberulous on the nerves below, 7-12 cm long, 2-2.5 cm broad; midrib conspicuous above, prominulent below; transverse nerves conspicuous below; margin subentire or undulate; petiole 0.5-2 cm long. **Inflorescence** in terminal and lateral panicles, oblong, 7-15 cm long, densely glandular-pubescent; bracts towards the base of the panicle, glabrous, foliaceous, c. 1.5 cm long, the others very small, densely hairy, c. 4 mm long; bracteoles very small, similar to the upper bracts. **Calyx** 7 mm. long, densely glandular-hairy; sepals linear-acuminate, c. 0.5 mm broad, free almost to the base. **Corolla** pink, shortly glandular-pubescent outside, c. 2.5 cm long; tube ventricose from c. 5 mm above the base; limb subequally 5-lobed. **Stamens** 2 fertile inserted near the base of the corolla; filaments c. 10 mm long, hairy at the base; anthers oblong, c. 4 mm long. **Ovary** glandular-hairy; style hairy towards the base. **Capsule** c. 2.5 cm long, densely glandular-hairy, 12-seeded.

Thailand.— NORTHERN: Ching Mai (Hot), Nan (Doi Phu Kha), Lampang, Phrae, Sukhothai (Muang Kao), Kamphaeng Phet; NORTHEASTERN: Loei (Phu Luang); SOUTHWESTERN: Uthai Thani (Khao Nang Ram).

Distribution**.** — Myanmar, Thailand.

Ecology. — By stream, in mixed deciduous forest, c. 200 m.

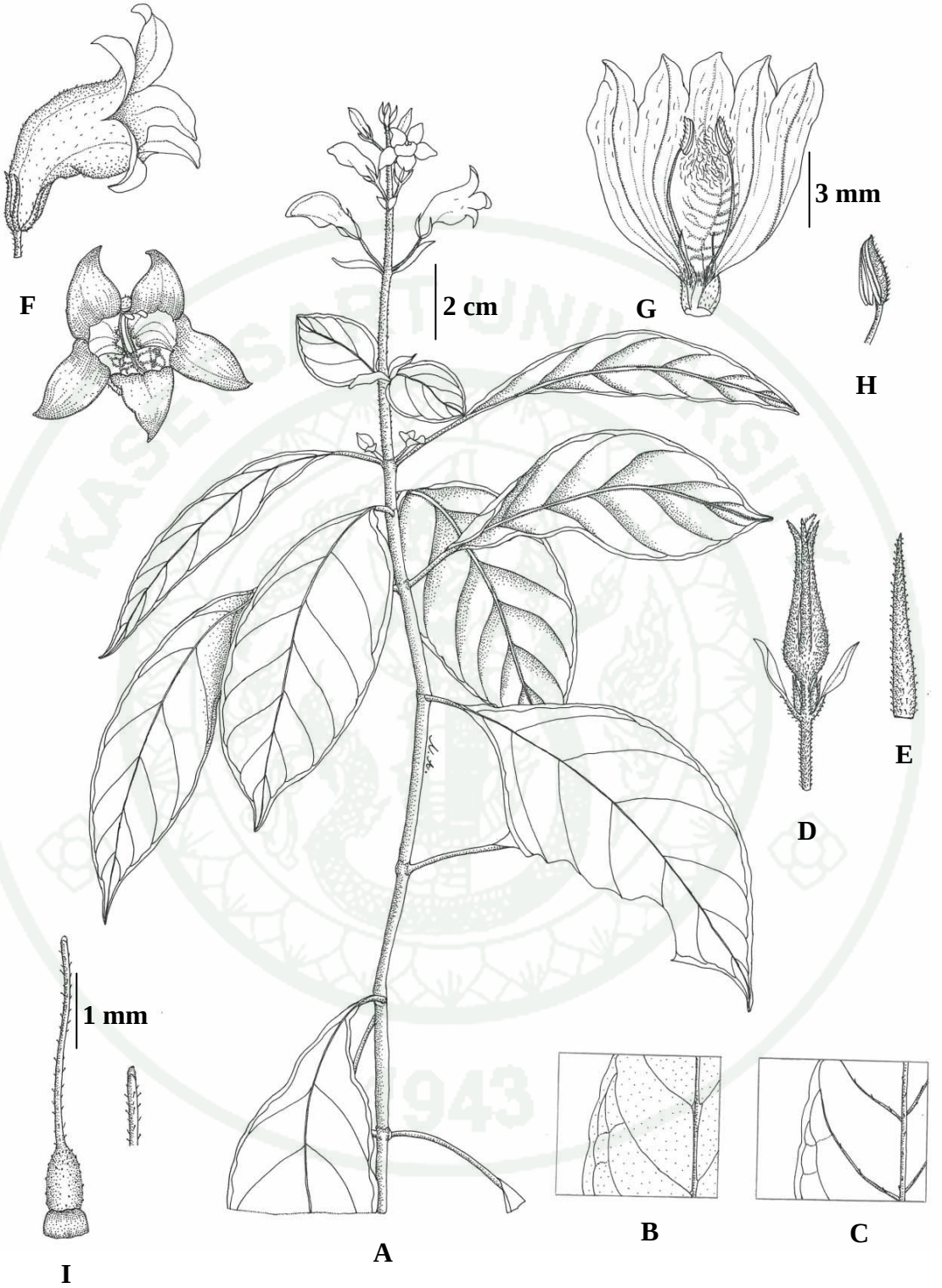

Figure 15 *Phlogacanthus paniculatus*: A. habit; B. the abaxial of leaf; C. the adaxial leaf; D. bract; E. bracteole; F. flower; G. longtitudinal section of flower; H. stamen; I. pistil. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 013030108-2 (BK)

7. Phlogacanthus pauciflorus J. B. Imlay *In* Bull. Misc. Inform. Kew. 129. 1939.

Shrub c.1 m high. Stems erect, quadrangular, puberulous, covered with thin bark, arising annually from a perennial rootstock. **Leaves** oblanceolate, oblong-lanceolate or broadly lanceolate, very shortly obtusely acuminate to the apex, cuneate at the base, chartaceous, minutely lineolate, puberulous on both surfaces, the lower surface drying very pale, 4.5-7 cm long, 1.5-2.6 cm broad; midrib and 6 pairs lateral nerves few, conspicuous below; margin ciliolate; petiole c. 1.5 cm long or less. **Inflorescence** in terminal raceme, to 3 cm long; bracts small, linear-lanceolate, c. 5 mm long, pubescent; bracteoles very small. **Calyx** c. 10 mm long, densely glandular-pubescent; sepals linear-lanceolate, c. 1 mm broad, free almost to the base. **Corolla** purple, glandular-pubescent outside, c. 2.5 cm long; tube narrow cylindrical at the base for c. 6 mm then curved and ventricose; limb subequally 5-lobed, the lobes rounded. **Stamens** 2 perfect inserted c. 6 mm from the base of the corolla; filaments hairy at the base only; anthers c. 4 mm long, shortly glandular at the back; staminodes absent. **Ovary** almost glabrous, or puberulous; style c. 1.5 cm long almost glabrous. **Capsule** c. 2.8 cm long, 12-seeded from the base.

Thailand. ── NORTHERN: Lamphun (Pa Sang), Tak.

Distribution. ── Thailand.

Ecology. ── In deciduous bamboo forest, c. 300 m. In moist mixed evergreen forest, c. 200 m. In teak jungle, c. 350 m.

8. Phlogacanthus pedunculatus J. B. Imlay *In* Bull. Misc. Inform. Kew 128. 1939.

Shrub c. 4.5 m high, rather straggling. Branchlets quadrangular, glabrous, covered with a thin light coloured bark, **Leaves** subequal, broadly lanceolate or ovate-lanceolate, tapering to the subacute apex, cuneate or shortly attenuate at the base, chartaceous, densely minutely lineolate, glabrous above, minutely softly pubescent below, 8-19 cm long, 4-8 cm broad; midrib and 8 pairs lateral nerves conspicuous above, prominent below; transverse nerves conspicuous below; petiole 1-4.5 cm long, minutely pubescent, **Inflorescence** terminal and on the lateral branches, a lax narrow panicle with branches distant, spreading, simple or cymose, glandular-pubescent, 1-2.5 cm long; lowermost bracts foliaceous, petiolate, c. 2 cm long; upper bracts very small; bracteoles small c. 0.5 mm long of less, glandular-pubescent. **Calyx** c. 1.2 cm long in flower, c. 1.7 cm long in fruit, densely glandular pubescent; sepals oblong, acuminate, c. 2 mm broad, the posterior sepal a little longer, free almost to the base. **Corolla** mauve, glandularpubescent outside, c. 2 cm long; limb subequally 5-lobed, the lobes rounded. **Stamens** 2 perfect, inserted near the base of the corolla tube, rudiments absent; anthers filaments c. 12 mm long; anthers c. 4 mm long. **Ovary** densely hairy, glandular towards the apex; style 1.4 cm long, hairy. **Capsule** c. 2.8 cm long, oblong-linear, slightly tapering at both ends; 4-sided almost grooved, glandular-pubescent. Seeds minutely verrucose and hairy, 12-seeded from the base.

Thailand.—NORTHERN: Lamphun (Li), Lampang (Chae Hom), Tak (Lan Sang); SOUTHWESTERN: Kanchana Buri (Si Sawat; Sai Yok), Uthai Thani (Khao Nang Ram).

Distribution. —Thailand.

Ecology. —By stream in evergreen forest, c. 200 m.

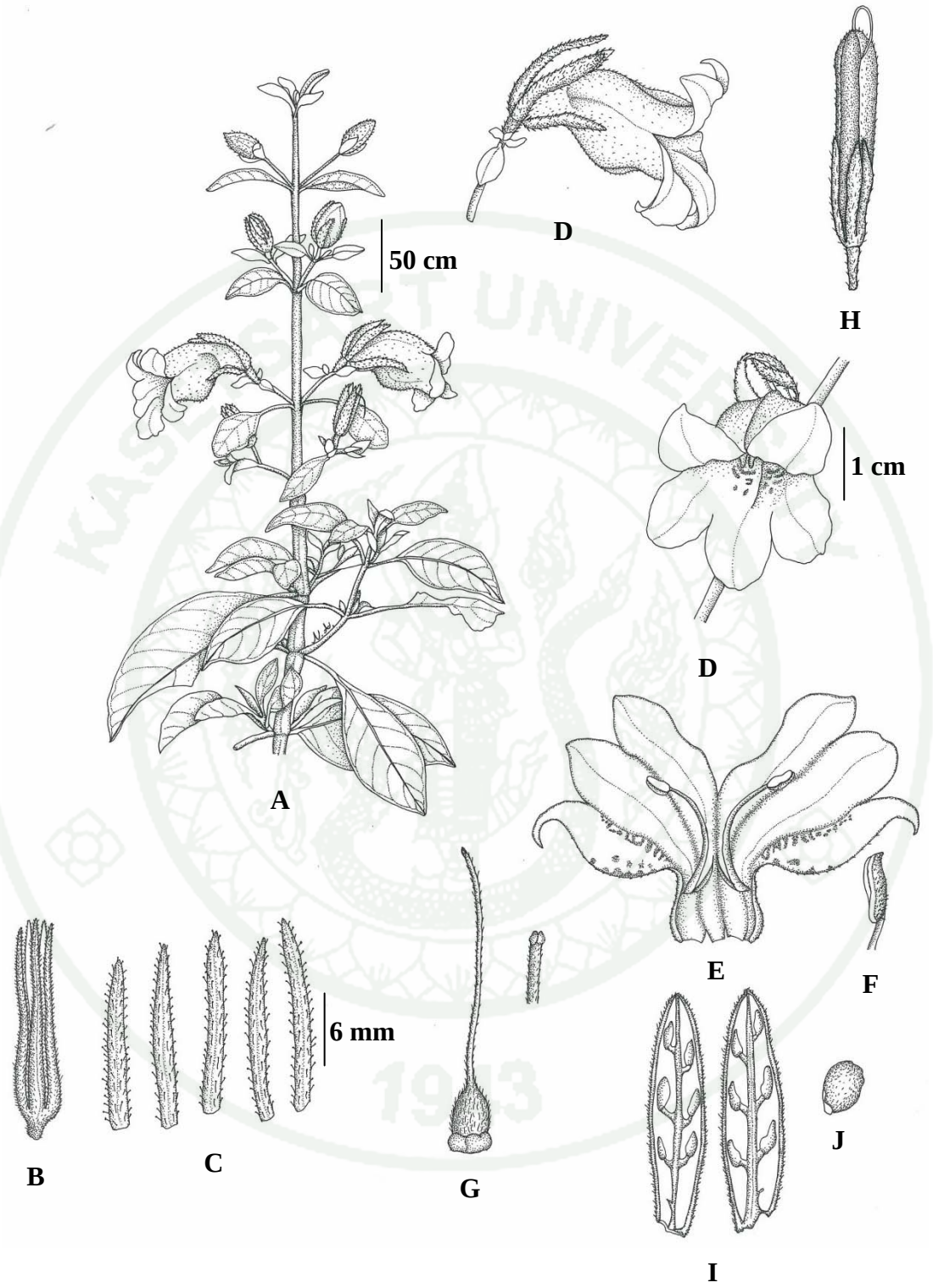

Figure 16 *Phlogacanthus pedunculatus*: A. habit; B. lowermost bract; C. sepal; D. flower; E. longtitudinal section of flower; F. anther; G. pistil; H. fruit; I. seed arrangement; J. seed; Drawn by Nongnoot Anuraktrakoon; All from Winai Somprasong 055210310-1 (BK)

9. Phlogacanthus pulcherrimus T. Anders. *In* Journ. Linn. Soc. 507. 1867. ── *Loxanthus Gomezii* Nees *In* DC. Prodr. 11: 322. 1847. ──*Cystacanthus turgidus* Nicholson Dict. Gard. i. 428. 1884. ──*Phlogacanthus turgidus* R. Ben. *In* Léc. Fl. Gén. I.- C. 4: 708. 1935. ──*Cystacanthus pulcherrimus* C. B. Clarke *In* Hook. f., Fl. Brit. Ind.4: 504. 1884. ──*Cystacanthus punctatus* Ridl., *In* Journ. As. Soc. Str. 104: 149. 1911.

Shrub c. 2 m high. Branchlets quadrangular, sub-alate, becoming almost cylindrical, glabrous. **Leaves** large lanceolate, oblanceolate, or elliptic, acuminate to the acute apex, attenuate at the base, lineolate, glabrous, 8-25 cm long, 2-8 cm broad; midrib and 8-10 pairs lateral nerves conspicuous above, prominent below, the lateral nerves arching upwards within the margin; transverse nerves conspicuous below; margin subentire; petiole 1-1.5 cm long. **Inflorescence** in terminal panicle, spikiform and thyrsoid, sometimes branches, 3-15 cm long; bracts small, lanceolate, foliaceous densely pubescent, 6-12 mm long, scattered throughout the panicle; bracteoles similar but narrower. **Calyx** 3-4 mm long, densely finely pubescent; sepals acuminate, free almost to the base. **Corolla** purple or mauve, tomentose outside in the bud, and white at the apex, the mature corolla becoming glabrous, 2.5-3 cm long; tube curved, the upper half ventricose; limb subequally 5-lobed, the lobes oblong, obtuse. **Stamens** 2, perfect inserted below the ventricose part of the corolla, hairy at the base anthers 4 mm long, oblong. **Ovary** glabrous; style puberulous. **Capsule** 3-4 cm long, glabrous.

Distribution**.** ──Thailand, Myanmar, Laos Vietnam, Malaysia (cultivated).

Thailand. ── EASTERN: Surin (Sangkha); SOUTHEASTERN: Trat (Ban Rai); PENINSULAR: Chumphon (Tha Sae), Ranong (Khlong Nakha), Phangnga (Takuapa).

Ecology. ──By stream, in evergreen forest, 10-200 m.

Vernacular**.** ── Di Pla Kang (ดีปลากั้ง), Di Wua Dam (ดีวัวดำ) (Surin)

Uses. ── Fresh leaves edible, bitter and sweetened taste.

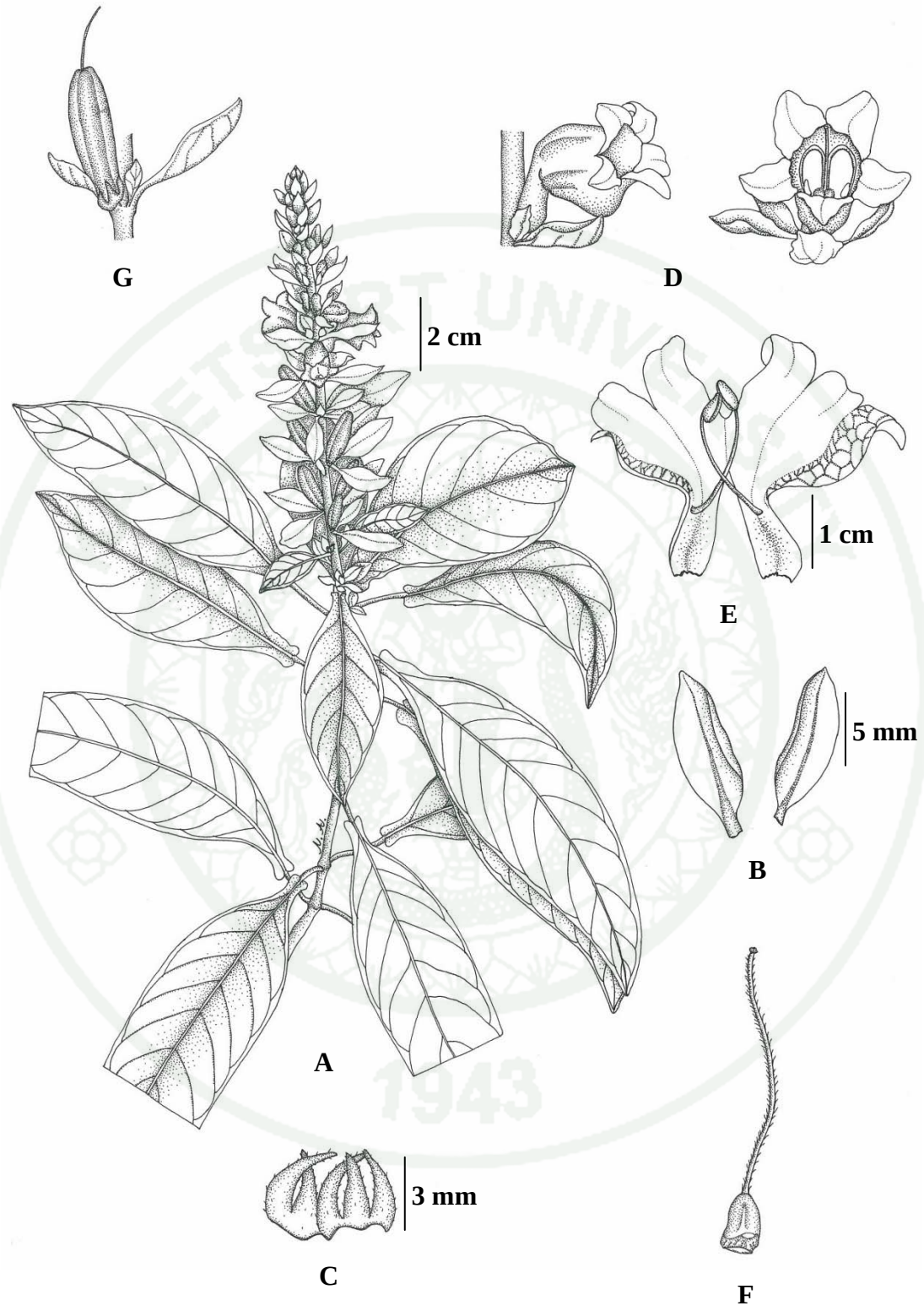

Figure 17 *Phlogacanthus pulecherrimus*: A. habit; B. bract; C. sepal; D. flower; E. longtitudinal section of flower; F. pistil; G. fruit. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 012121213-5 (BK)

10. Phlogacanthus racemosus Bremek. *In* Dansk Bot. Ark. 20: 76. 1961.

Undershrub, decumbent c. 1 m high. Stems erect, quadrangular, puberulous, covered with thin bark, arising annually from a perennial root-stock. **Leaves** elliptical, acuminate to the apex, cuneate at the base, chartaceous, minutely lineolate, puberulous on both surfaces, the lower surface drying very pale, 4-6 cm long, 08-1 cm broad; midrib and 6 pairs lateral nerves few, conspicuous below; margin ciliolate; petiole c. 1.5 cm long or less. **Inflorescence** in terminal raceme, to 3 cm long; bracts small, linear-lanceolate, c. 5 mm long, pubescent; bracteoles very small. **Calyx** c. 10 mm long, densely glandular-pubescent; sepals linear-lanceolate, 1 mm. broad, free almost to the base. **Corolla** purple, grabrous, c. 1.8 cm long; tube narrow cylindrical at the base for 4.5 mm; limb subequally 5-lobed, the lobes rounded. **Stamens** 2 perfect inserted c. 6 mm from the base of the corolla; filaments hairy at the base only; anthers c. 4 mm long, shortly glandular at the back; staminodes absent. **Ovary** almost glabrous, or puberulous; style c. 1 cm long almost glabrous. **Capsule** not seen.

Thailand. ―NORTHERN: Chiang Mai (Doi Saket; San Kamphaeng), Lampang (Doi Khun Tan; Muang Pan), Phayao (Doi Luang), Sukhothai (Ramkhamhaeng National Park), Kamphaeng Phet (Khlong Lan).

Distribution.― Thailand.

Ecology. ― In deciduous forest with bamboo, c. 340 m. Shaded area along stream, c. 1,500 m. Open disturbed area. Fire-damaged area. Secondary growth area with bamboo.

11. Phlogacanthus rectiflorus J.B. Imlay *In* Bull. Misc. Inform. Kew. 130. 1939.

Shrub up to 0.3 m high. Branchlets 4-angled when young, covered with a fairly loose thin bark, minutely pubescent. **Leaves** oblanceolate or obovate, shortly acuminate to the acute apex, attenuate at the base, glabrous on both surfaces except the nerves puberulous below, the upper surface conspicupusly black dotted, 7-12 cm long, 2.5-5.8 cm broad; midrib and 6-7 pairs lateral nerves conspicuous above, prominent below, the lateral nerves curving upwards within the margin; transverse nerves sub-obscure; margin subentire of obscurely crenulate, slightly recurved, glabrous petiole 1-2.5 cm long, almost glabrous. **Inflorescence** terminal, short, c. 3 cm long, pubescent; upper flowers solitary on a pedicel c. 2 mm long, the lower flowers in small few-flowered cymes on short peduncles, c. 2 mm long; bracts linear-oblanceolate, acute, densely pubescent, 4-5 mm long; bracteoless similar to the bracts but inserted near the middle of the pedicel. **Calyx** c. 4 mm long, densely minutely pubescent outside; sepals tapering acute, united at the base for c. 1 mm, puberulous inside, and minutely ciliate. **Corolla** white spotted crimson, pubescent outside, 2.5 cm long; tube straight erect, not curved, inflated gradually from c. 5 mm above the base, glabrous inside except at the level of the staminal insertion: lobes sub-bilabiate, oblong or ovate, apiculate at the apex, c. 8 mm long, the two posterior lobes united at the bass for c. 2 mm and forming an obscure upper lip. **Stamens** 2, fertile, and 2 small rudiments, inserted c. 6.5 mm from the base of the corolla, filaments 1.3 cm long, glabrous except for a tuft of hairs at the base; anthers oblong, c. 4 mm long, pubescent and glandular at the back. **Ovary** glabrous; style glabrous. **Capsule** oblong, c. 2.4 cm long, glabrous, each valve 3-grooved. Seeds, flattened, ovoid, black with a brown margin, minutely puberulous, 8-seeded.

Thailand. — PENINSULAR: Phangnga (Bangto), Ranong (Kaper).

Distribution. — Thailand.

Ecology. — In evergreen scrub, c. 100 m.

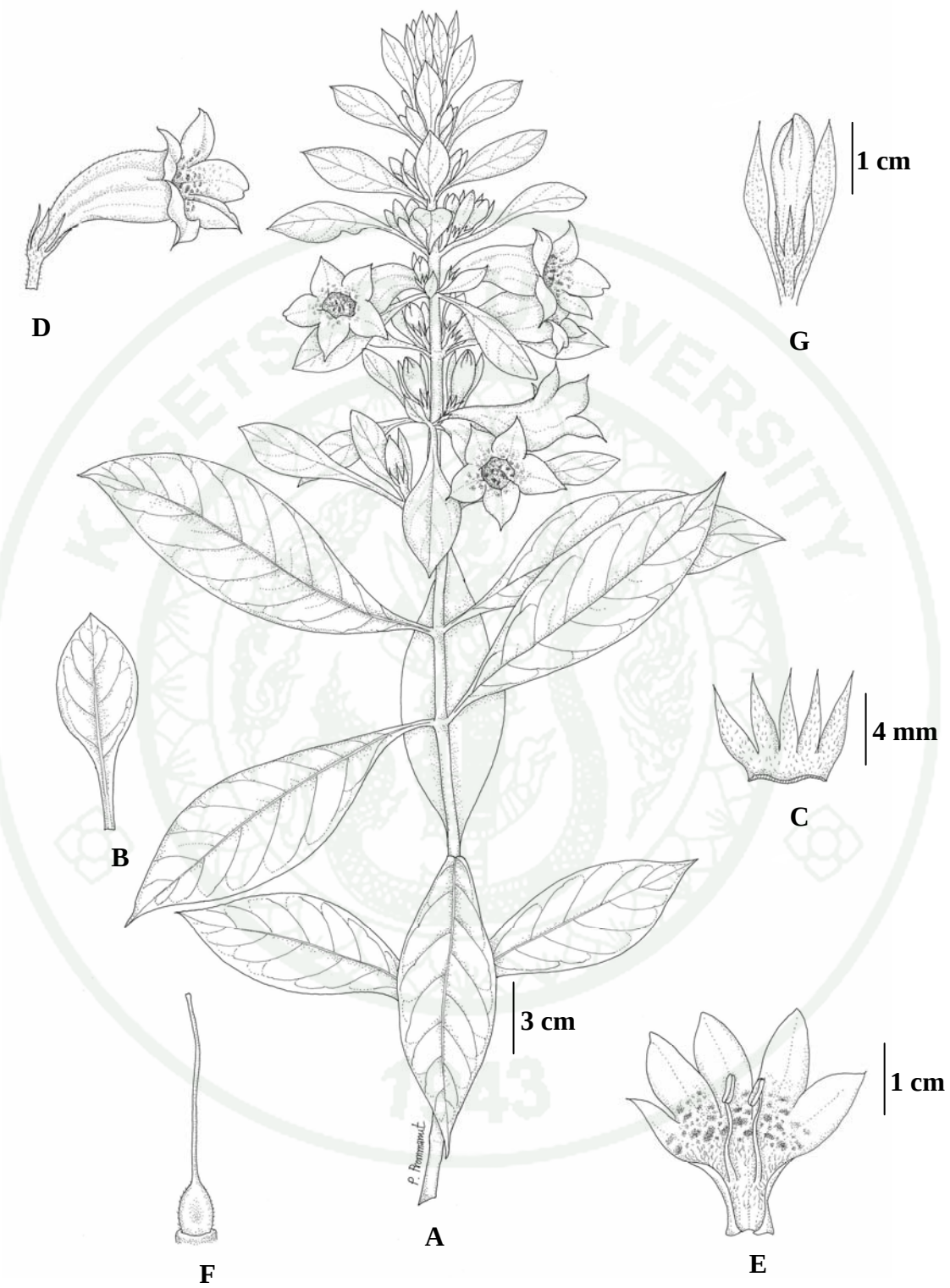

Figure 18 *Phlogacanthus rectiflorus*: A. habit; B. bract; C. sepal; D. flower; E. longtitudinal section of flower; F. pistil; G. fruit. Drawn by Phattaravee Phrommanat. All from Winai Somprasong 062280308-2

12. Phlogacanthus vitellinus T. Anders. *In* Journ. Linn. Soc. 9: 507. 1867.

Shrub c. 0.3 – 1 m high, branched. Branchlets sharply 4 –angled when young, becoming obtusely quadrangular, sparingly puberulous upwards or almost glabrous. **Leaves** petiolate, broadly elliptic, some lanceolate, shortly acuminate to the acute apex, tapering to acute at the base, glabrous except the nerves minutely puberulous below, 10-17.5 cm long, 3-8 cm broad; midrib conspicuous above, prominent below; lateral nerves 6-8 pairs, conspicuous above, prominent below; margin subentire, glabrous; petiole 1-1.5 cm long, glabrous. **Inflorescence** a narrow terminal panicle, 2-6 cm long,1-2 cm broad; upper flowers solitary, opposite, the lower flowers in small shortly peduncled cymes; pedicels c. 3 mm long or less; peduncles and pedicels shortly pubescent; bracts at the base of the pedicel, lanceolate, acuminate, shortly pubescent, 3-4 mm long; bracteoles c. 1.5 mm long, linear, shortly pubescent, affixed about the middle of pedicel. **Calyx** shortly pubescent outside, 4.5-5 mm long; sepals lanceolate, acuminate, united at the base for c. 1.25 mm, shortly pubescent inside towards the apex,minutely ciliate, 3-nerved. **Corolla** pink with yellow patch on lower lip, or red, densely shortly pubescent outside, many hairs glandular, 0.8-1.2 cm long; tube narrow at the base, then suddenly curved and inflated, glabrous inside except for an incomplete ring of short hairs near the throat; limb shortly obscurely bilabiate; lobes 3-5 mm long, ovate or ovate-oblong, acute, puberulous inside towards the margin. **Stamens** 2 fertile and 2 minute rudiments inserted c. 5 mm from the base of the corolla; filaments c. 6 mm long, curved, shortly hairy at the base; anthers exserted, oblong, c. 2.5 mm. long, glandular at the back. **Ovary** glabrous. 8-ovulate; style c. 9 mm long, glabrous. **Capsule** c. 1.7 cm long, glabrous, 8-seeded from the base.

Thailand.— SOUTHEASTERN: Nakhon Nayok (Pak Phli), Rayong, Chanthaburi (Khao Sabap).

Distribution. — India, Myanmar, South China, Thailand.

Ecology. — By stream, in evergreen forest, 100-400 m.

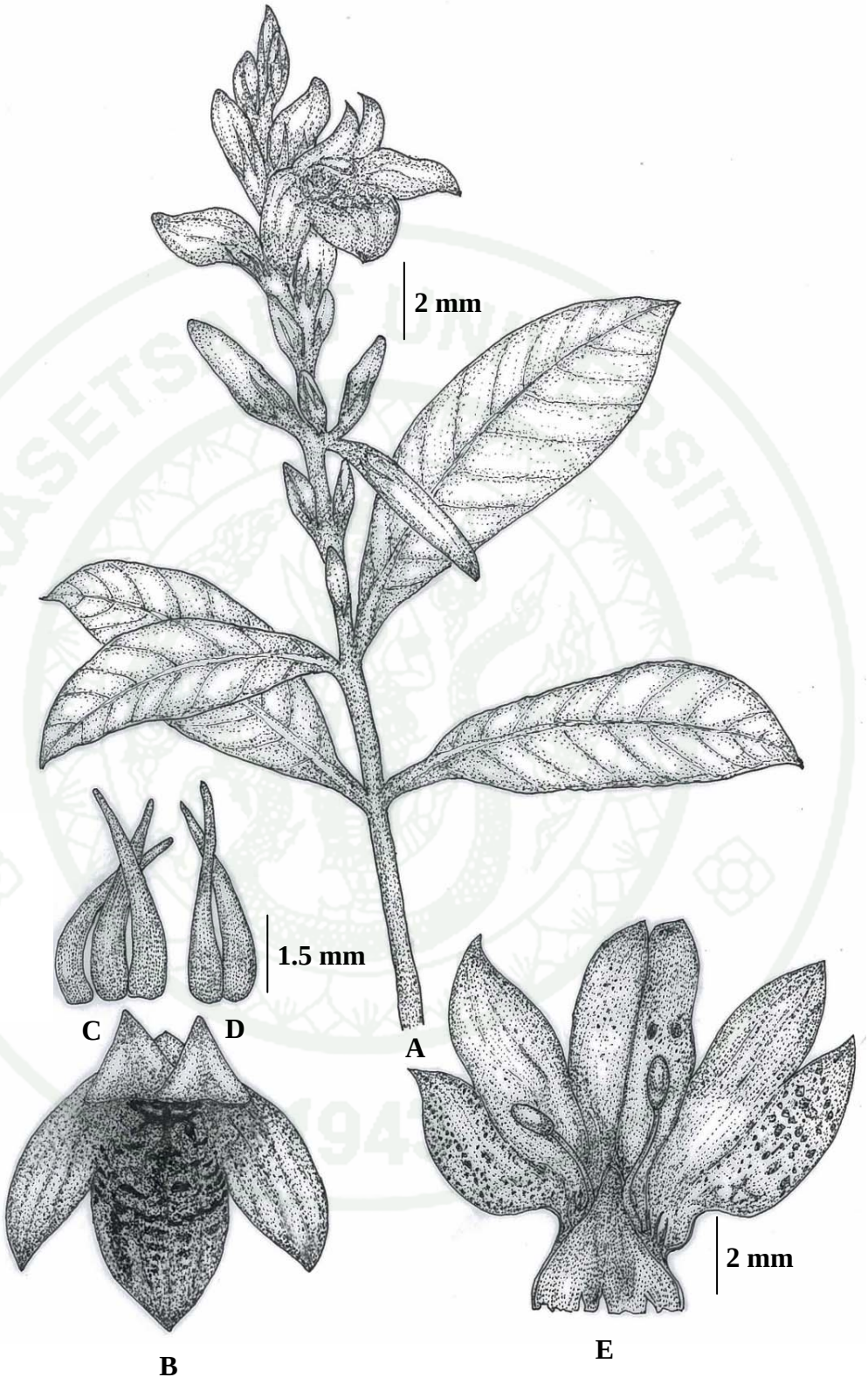

Figure 19 *Phlogacanthus vitellinus*: A. habit; B. flower; C. bract; D. calyx; E. longtitudinal section of flower. Drawn by Jessada Tengrang. All from Winai Somprasong 035150113-4 (BK)

1. BARLERIA

L. Sp. Pl. 636. 1753; L., Gen. Pl. ed. 5. 284. 1754; Nees *In* DC. Prod. 11: 222. 1847; Benth. & Hook.f., Gen. Pl. 2: 1091. 1876. Type species: *Barleria cristata* L.

Herbs or undershrubs, unarmed or spinescent, axillary spines 1-4- armed**.** **Leaves** opposite, usually entire, sometimes spinous at the apex. **Flowers** blue, mauve, purple, white or yellow, solitary in the axils of upper leaves, or **Inflorescence** in terminal spikes, sometimes in axillary cymes; bracts large, ovate or lanceolate, small or absent; bracteoles usually small, linear, sometimes spiniform. **Calyx** 4-partite, the sepals in opposite pairs; 2 outer larger, anterior sepal a little smaller often bilobed or emarginated at the apex, entire or dentate, 2 inner sepals lateral, usually linear and entire. **Corolla** tube long, cylindrical or infundibuliform; limb subequally 5-lobed or bilabiate, the anterior petal usually separate from the others at a lesser or greater distance down the tube forming the lower lip; lobes imbricated in the bud. **Stamens** inserted below the throat of the corolla tube, 2 anterior fertile, long, often exsweted, and 2 small rudimentary rarely carrying pollen, the rudimentary posterior often present; anther cells 2, oblong, equal. **Ovary** bilocular, 4-ovulate; disc membranous, copular, entire or sinuate; style entire or shortly 2-fid at the apex. **Capsule** oblong, sometimes with a short solid beak at the apex, 2-4 seeded. Seeds ovate, much compressed, densely covered with dark, wavy, silky, inelastic hairs; borne on curved jaculator.

About 250 species from tropical and subtropical Africa, tropical Asia, and America. Most of the species are African. 6 species are recorded from Thailand.

Key to the species

1. Plant armed with axillary spines; flowers yellow; capsule with small solid beak:
   2. Flowers mostly axillary, 1-3-together; bracts similar to the leaves but smaller; leaves ovate **4. B. prionitis**
   2. Flower in terminal ovoid spikes; bracts large, ovate, imbricated; leave linear-lanceolate **3. B. lupulina**
1. Plant without axillary spines; flowers mauve or purple; capsule without solid sterile beak:
   3. Bracts and sepals spinous at the apex.
      4.Sepals markedly spinous-dentate; anterior sepal sometimes irregularly emarginated at the apex **2. B. cristata**
      4.Sepals quite entire; anterior sepal deeply 2-lobed **1. B. biloba**
   3. Bracts and sepals not spinous at the apex
      5.Spikes many-flowered, in 1-sided of axil; leaf base long attenuate **6. B. strigosa**
      5.Cymes short, few-flowered, in pairs of each axil; leaf base shortly cuneate **5. B. siamensis**

1. Barleria biloba J.B. Imlay *In* Kew Bull. 1937: 124. 1937.

Straggling shrub, c. 30 cm high. Branchlets subterets, densely lineolate, glabrous, nodes distant, strigose. **Leaves** petiolte, subequal, ovate, shortly acuminate to the acute apex, suddenly shortly attenuate at the base, upper surface lineolate and with a few scattered strigose hairs especially on the nerves, villous below, younger leaves more densely hairy, 4-10 cm long, 2-6.5 cm broad; midrib conspicuous above prominent below; lateral nerves 4 pairs, prominulent below; transverse nerves, numerous, more or less parallel; margin entire, sofly cillate; petiole 1-2 cm long. **Inflorescence** in terminal spike and on lateral branches, sometimes axillary, dense, oblong or ovate, 2-6 cm long, 2-3 cm broad; bracts broadly ovate or elliptic, acuminate to the apex, which is cuspidate and recurved, 2-2.3 cm long, 7-10 mm broad, conspicuously 3-nerved, shortly pubescent and pilose on both surfaces, margin minutely denticulate, shortly ciliate, often glandular, and long-ciliate, the hairs white and silky; bracteoles oblong, apiculate at the apex, c. 1.5 cm long, c. 2 mm broad, midrib conspicuous, almost glabrous inside, pubescent and with a few longer hairs outside, margin shortly glandular-ciliate and long-ciliate. **Calyx**, sepals quite entire; anterior sepal deeply 2-lobed; outer sepals subequal, oblong-acuminate, shortly cuspidate at the apex, 5 – nerved, green or purple tipped, the posterior larger, 2.3–2.5 cm long, 6-7 mm broad, shortly pubescent and polose on both surfaces, margin shortly glandular-ciliate and long-ciliate the anterior c. 2 cm long, 6-7 mm broad, deeply 2- lobed; lateral sepals linear-acuminate, c. 1.3 cm long, midrib, spicuous, shortly pubescent, often glandular, and long hairy. **Corolla** pale mauve, c. 4.5 cm long, puberulous outside; tube narrow, straight, tapering slightly towards the apex, c. 2.7 cm long; anterior lip monopetalous, free c. 11 mm from the base of the tube, posterior lobes oblong or obovate, 1.5-1.9 cm long. **Stamens** 2 very long, fertile, exsert, c. 4 cm long, glabrous, with anthers oblong c. 6 mm long inserted below the middle of the tube with 2 very small sterile stamens and a minute posterior rubiment, softly pilose at the base. **Ovary** pubescent towarda the apex; style c. 5.2 cm long, sparingly hairy near the base. **Capsule** 1.7 cm long, minutely pubescent towards the apex, oblong-acuminate. Seeds round, much compressed, densely black silky hairy, 4-seeded to the apex.

Thailand. — CENTRAL: Lop Buri (Chaibadan), SOUTHWESTERN: Prachuap Kiri Khan.

Distribution**.** — Thailand.

Ecology. — On limestone hill in dry evergreen forest. In mixed forest, c. 100 m.

Vernacular. — Angkap Khao **(**อังกาบเขา**)** (Prachuap Khiri Khan).

2. Barleria cristata L., Sp. Pl. 636: 1753; Roxb., Fl. Ind. 3:37. 1832; Nees *In* DC., Prod. 11:229. 1847; Clarke *In* Fl. Brit. Ind. 4:488. 1885; Trimen, Hanb. Fl. Ceylon 3:321. 1895; Craib *In* Bull. Misc. Inform., Kew 1911: 437. 1911; Benoist *In* Fl. Gén. I.- C. 4: 687. 1935; Back. & Balkh. f., Fl. Java 2: 572.1965. Type from India.

Small shrub, sometimes straggling, 0.5 – 2 m high, erect or diffuse. Branchlets terete, often slightly swollen at the nodes, appressedly yellow hairy, velvety when young, often becoming glabrous. **Leaves** lanceolate or oblong-elliptic, acute at the apex, cuneate or attenuate at the base, lineolate, softly yellowish hairy above and below, especially on the nerves, or almost glabrous, (in the prostrate form with leaves almost glabrous the hairs have rough tubercular bases which persist after the hairs have fallen off) 4-14 cm long, 2.5-5 cm broad; midrib and 6 pairs lateral nerves conspicuous above, prominent below: transverse nerves numerous, parallel; margin entire, slightly recurved, pubescently ciliate; petiole 5-10 cm long, softly pubescent. **Inflorecscence** with flower in terminal ovoid spikes; bracts large, ovate, imbricated; bracts linear or lanceolate; acute and cuspidate at the apex, 0.9 – 1.8 cm long, 1-2 mm broad, nervosa, margin obscurely or deeply toothed, glandular-ciliate; bracteoles similar to the bracts. **Calyx** outer sepals ovate-acuminate of lanceolate, sparsely hairy or almost glabrous, conspicuously nerves, usually tinged purple, anterior sepal a little smaller often irregularly bifid or sepals markedly spinous-dentate; anterior sepal sometimes irregularly emarginated at the apex, 2-3 cm long, 6-9 mm broad, margin spinous-toothed and shortly glandular-ciliate; inner sepals small, linear-lanceolate, entire, c. 8 mm long. **Corolla** purple, puberulous outside, 5-6 lobed; tube c. 3 cm long, glabrous inside, infundibuliform; lobes obovate, 1.5-2 cm long, glabrous, anterior lobe more deeply separated and a little larger. **Stamens** 2 long fertile, c. 2.5 cm long, puberulous, with anthers oblong, curved, 2 small with sterile anthers, c. 7 mm long, and the very small rudimentary posterior stamen, inserted about the middle of the corolla tube. **Ovary** glabrous; style c. 4.3 cm long. **Capsule** c. 1.5 cm long, black, shining, glabrous, alves oblong, acuminate to the apex, 4 – seeded.

Thailand.— NORTH: Mae Hong Son (Pai; Tham Pla; Mae Saring), Chiang Mai (Hot; Inthanon; Chian Dao; Mae Chaem; Mae Taeng ; Chom Thong; Doi Suthep ; Om Koi ; Sop Aep; Mae Taman; Phrao; Mae Sa Valley), Ching Rai (Mae Lao; Wiang Pa Pao), Lamphun (Li), Lampang (Huai Prao; Doi Khun Tan), Tak (Umphang), Kamphaeng Phet (Khao Son); NORTHEASTERN: Phetchabun (Nam Nao); EASTERN: Chaiyaphum (Phu Khieo), Nakhon Ratchasima (Pakchong); SOUTHWESTERN: Prachuap Khiri Khan (Sam Roi Yot), Kanchana Buri (Tha Khanun; Si Sawat; Khao Laem Dam; Tham Than Rot), Uthai Thani (Ban Rai; Lansak); CENTRAL: Saraburi (Na Phra Lan), Bangkok.

Distribution. — India, Myanmar, China, Vietnam, Laos, Thailand.

Ecology. — In deciduous forest, 300 – 900 m. In open area in evergreen forest, 50-300 m.

Vernacular. —Angkap (อังกาบ), Toi Ting (ต้อยติ่ง) Thao Luem Thao Yai (เท้าลืมเท้าใหญ่)

Uses. —Growing in gardens as ornamental plant. Root used as a tonic. Root pounded for applying to cure insect poison. Whole plant boiled and used to bath for curing abnormal menses.

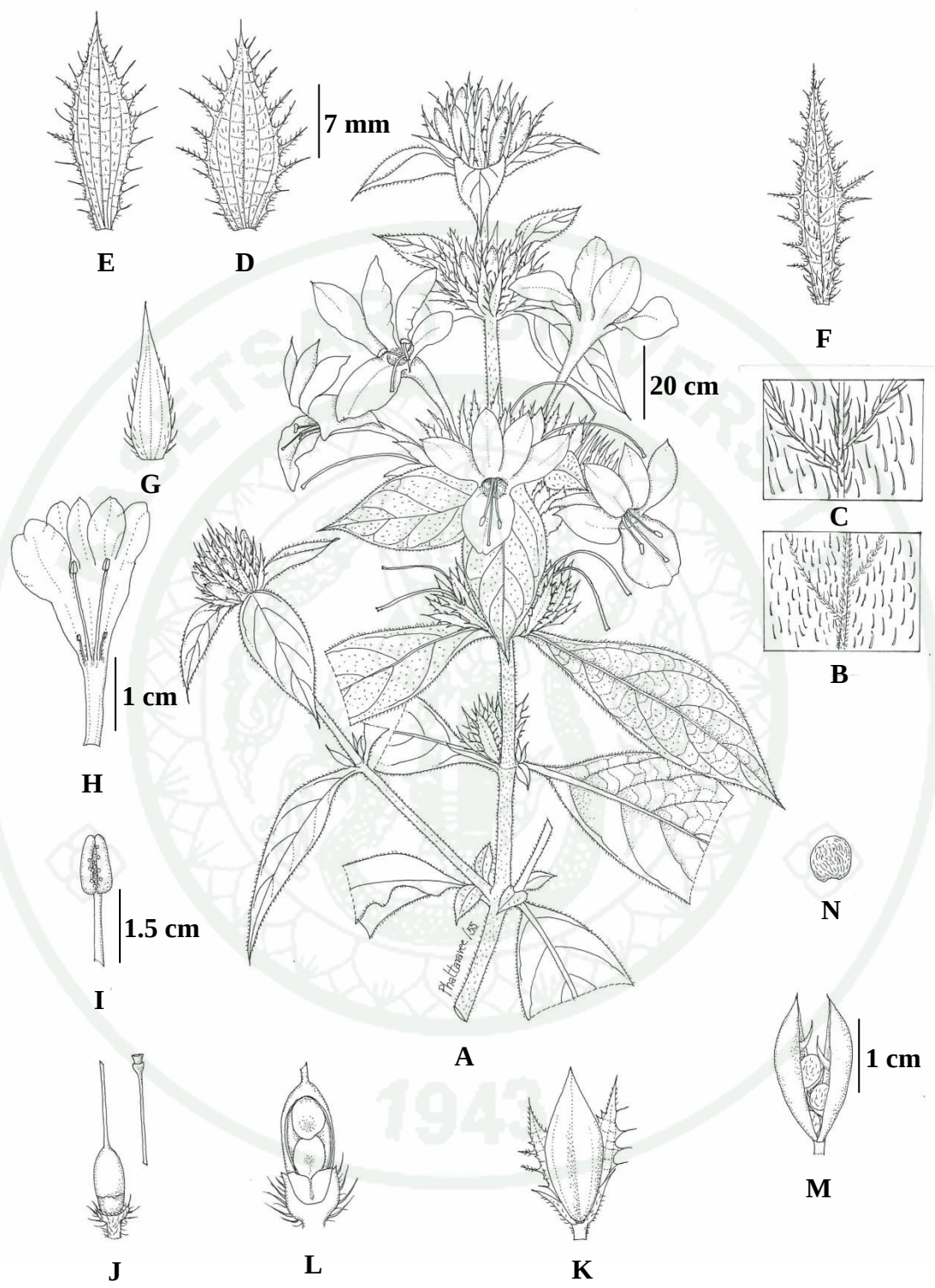

Figure 20 *Barleria cristata*: A. habit; B. the abaxial of leaf; C. the adaxial of leaf; D. bract; E. bracteole; F. outer sepal; G. anterior sepal; H. longtitudinal section of flower; I. stamen; J. pistil; K. fruit; L. seed arrangement; M. capsule dehiscence; N. seed; Drawn by Phattaravee Phrommanat. All from Winai Somprasong 012011207-4 (BK)

3. Barleria lupulina Lindl., Bot. Reg. t. 1: 1483; Craib *In* Bull. Misc. Inform., Kew 1911: 437. 1911; Benoist *In* Gén. I-C. 4: 687. 1935; Back. & Balkh. f., Fl. Java 2: 572. 1965.

Erect shrub, c. 2 m high, frequently cultivated. Branchlets purplish-brown, subterete, glabrous. **Leaves** narrow, oblong-linear and lanceolate-linear, acute and cuspidate at the apex, shortly attenuate at the base, upper leaves sometimes oblanceolata, obtuse and mucronata at the apex, glabrous and lineolate on both surfaces, 3-10 cm long, 1.2 – 1.5 cm broad; midrip reddish, conspicuous above and sunken towards the base, prominent below; lateral nerves 7-8 pairs, ascending and linked with in the entire margin; petiole reddish, c. 5 m long; axillary spines 2-3 armed, divaricate, **Inflorescence**: a terminal spike, ovate or oblong with bracts imbricated, c. 5 cm long; bracts large, ovate, obtuse and shortly spinous at the spex, 1.8–2 cm long and broad, lineolate and shortly pubescent outside, margin purple, entire; bracteoles narrow, subulate, acyte, pubescent, c. 6 mm long. **Calyx** outer sepals broadly lanceolate, spinous-acute at the apex, pubescent, c. 1.2 cm long, c. 4 mm boad; lateral sepals linear, spinous-acute at the apex, pubescent, c. 8 mm long, c. 1.5 mm broad. **Corolla** yellow, 4-4.5 cm long, puberylous outside; tube straight, cylindrical; anterior lobe free c. 1.5 cm from the base of the tube, nuch lower than, the others posterior lobes oblong, subequal. **Stamens** 2 long fertile, c. 2.1 cm long, glabrous, exserted, with anthers oblong c. 3.5 mm long, 2 lateral very small, sterule, ciliate at the base, and a minute posterior rudiment, inserted c. 10 mm. from the base of the corolla tube. Ovary glabrous; style c. 2 cm long. **Capsule** c. 1.2 cm long, beaked, glabrous, 2-seeded at the base.

Thailand. — NORTH: Nan (Tham Phatup), Tak (Bhumibol Dam); CENTRAL: Bangkok (Phra Khanong), Nakhon Nayok (Nang Rong).

Distribution.— Madagascar, India, Cultivated in tropical India, and wild as an escape.

Ecology. — Cultivated.

Vernacular.— Salet Phangphon (เสลดพังพอน) Chong ra-a (ชองระอา).

Uses.— Root pounded for an extraction to cure insect poison, grinded with liquor to cure poison and to be applied for curing skin disease.

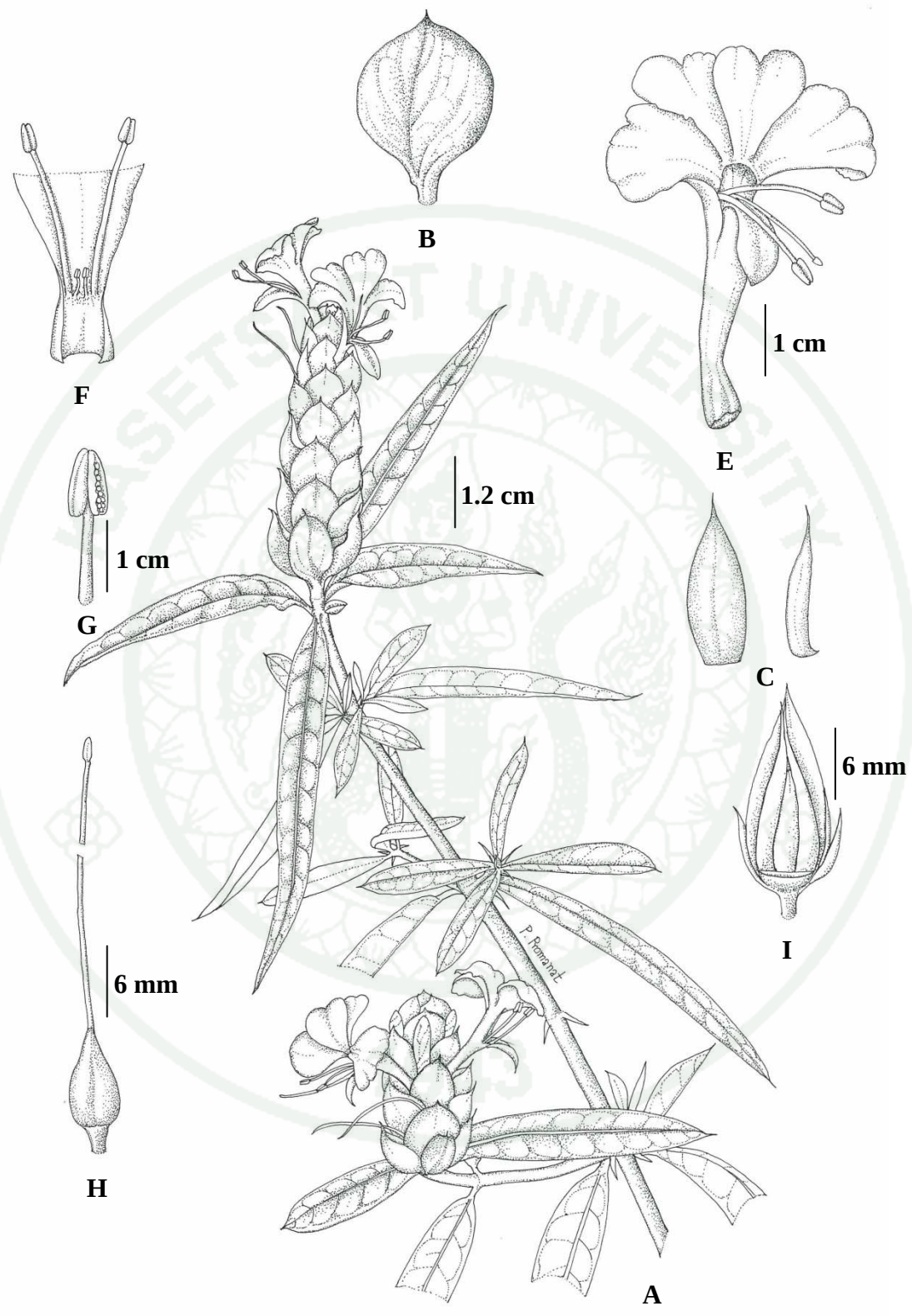

Figure 21 *Barleria lupulina*: A. habit; B. bract; C. outer sepal; D. lateral sepal; E. flower; F. stamen position; G. stamen; H. pistil; I. fruit. Drawn by Phattaravee Phrommanat; All from Winai 052080112-1 (BK)

4. Barleria prionitis L., Sp. Pl. 127: 1753; Clarke *In* Fl. Br. Ind. 4:482. 1885; Ridl., Fl. Malay Pen.2: 587. 1923; Benoist in Gén. I- C. 4: 686. 1935; Back. & Balkh. F., Fl. Java 2: 572.1965.

Small shrub, c. 1 m high, much branched. Branchlets sub-quadrangular, glabrous. **Leaves** elliptic, ovate and ovate-elliptic, acuminate and cuspidate at the apex, long attenuate at the base, lineolota on both surfaces, glabrous or with a few scattered hairs above, sparingly pilose below; midrib grooved above, prominent below; lateral nerves 4-5 pairs, conspicuous above and below; margin entire; petiole of the lower leaves 1-1.5 cm long; axillary spines 3-4 armed. **Flower** mostly axillary, 1-3-together; bracts similar to the leaves but smaller; or **Inflorescence** in 1-3 together, uppermost forming a terminal spike; uppermost leaves reduced to bracts, c. 1.8 cm long, 3 mm broad, spinous at the apex, glabrous, margin sparingly ciliate; bracteoles linear, cuspidate, 1-1.8 cm long, c. 2 mm broad. **Calyx**: outer sepals broadly lanceolate, spine-tipped, 1.4-1.8 cm long, c. 4 mm broad, glabrous; lateral sepals narrow-lanceolate, c. 1 cm long, c. 1.5 mm. broad, glabrous. **Corolla** yellow, puberulous outside, c. 4.5 cm long; tube infundibuliform; limb bilabiate, anterior lip monopetalous. **Stamens** 2, long fertile, c. 3 cm long, glabrous with anthers linear, c. 3 mm long, and 2 very small sterile. **Ovary** glabrous; style c. 3 cm long, glabrous. **Capsule** c. 1.6 cm long, beaked, glabrous. Seeds at the base of the capsule, 2-seeded.

Thailand**.** ―SOUTHWESTERN: Kanchana Buri (Ban Kao; Sanghkla Buri; Si Sawat), Phetchaburi (Cha-am; Muang); CENTRAL: Bangkok (Bangkhen); SOUTHEASTERN: Chon Buri (Siracha); PENINSULAR: Nakhonsi Thammarat (Khiriwong); Phangnga (Suwan Khuha Cave)

Distribution**.** ―Tropical Africa, cultivated in Tropical Asia.

Ecology. ― Cultivated.

Vernacular. ―Angkap Nu (อังกาบหนู) Salet Phangphon (เสลดพังพอน) Khieo Kaew (เขี้ยวแก้ว) (Central).

Uses. ―A preparation from the roots is used as a febrifuge. The juice of the leaves is applied externally to the feet to prevent the skin from cracking.

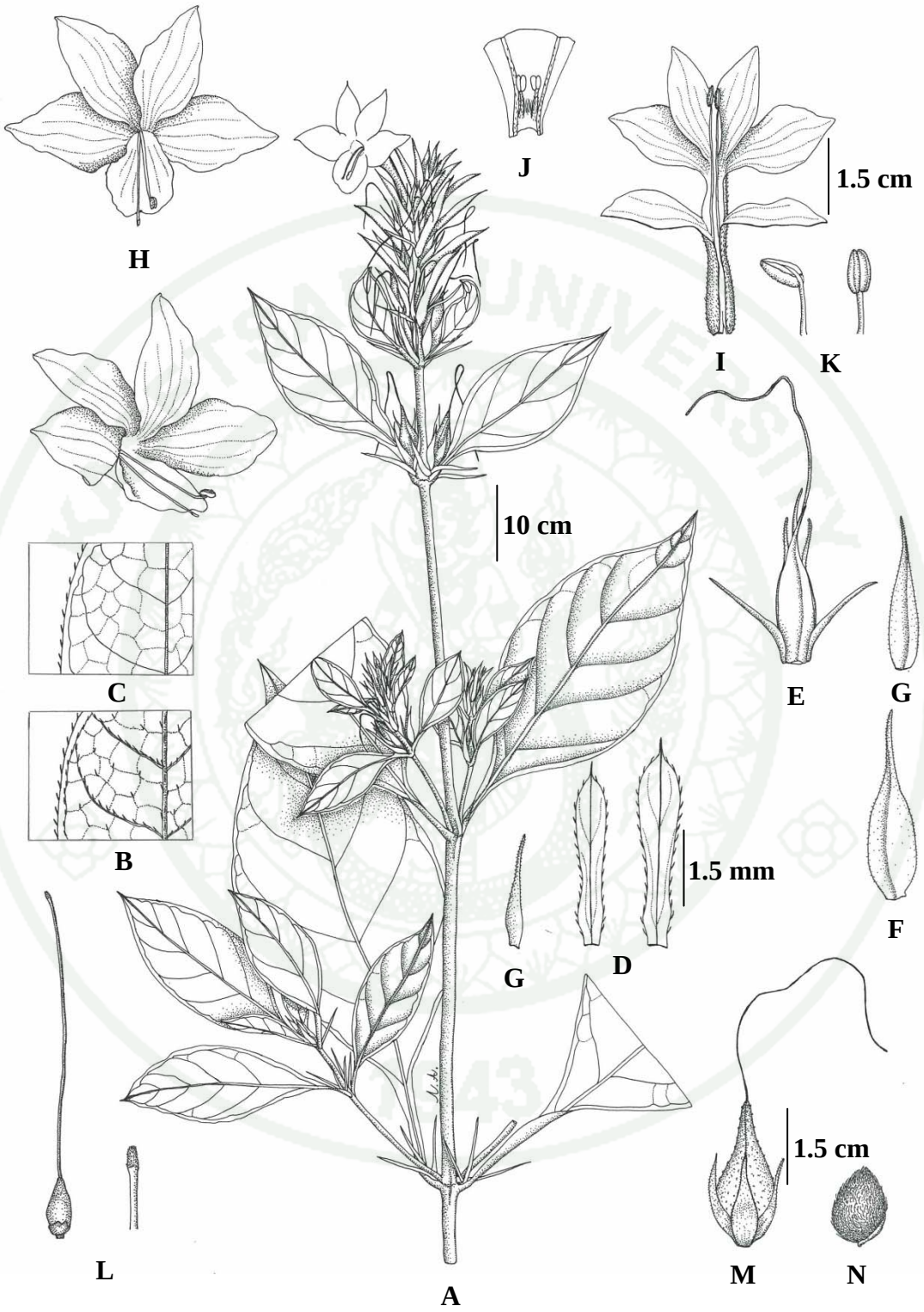

Figure 22 *Barleria prionitis*: A. habit; B. the abaxial of leaf; C. the adaxial of leaf; D. bract; E. bracteole; F. outer sepal; G. lateral sepal; H. flower; I. longtitudinal section of flower; J. position of stamen; K. stamen; L. pistil; M. fruit; N. seed. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 013040108-2 (BK)

5. Barleria siamensis Craib *In* Kew Bull. 437. 1911.

Shrub to c. 1 m high. Branchlets terete, yellowish strigose, especially at the nodes and apex. **Leaves** elliptic-lanceolate or elliptic, long acuminate to the acute apex, cuneate or suddenly or shortly attenuate at the base, upper surface lineolate, with scattered short stiff hairs, nerves pubescent below, 8.5 – 21 cm long, 3.8-7.5 cm broad; midrib conspicuous above, prominent below; lateral nerves 6 pairs, conspicuous; transverse nerves numerous; margin subentire, sparingly ciliate; petiole 1-1.5 cm long, pubescent. **Inflorescence** in axillary and terminal cymose clusters, short, few-flowered, in pairs of each axil, subsessile; bracts liner-lanceolate, acute, c. 11 mm long, c. 1.5 mm broad, mudrib conspicuous; bracteoles c. 8 mm long, lanceolate. **Calyx**: Outer sepals large, ovate-acuminate, acute, posterior sepal c. 3 cm long; c. 1.5 cm broad, strigose on both surfaces, margin very shortly dentate-ciliate, anterior sepal similar but smaller and emarginated at the apex, c. 2.5 cm long, c. 1.3 cm broad; lateral sepals linear, acute, c. 1.2 cm long, c. 1.5 mm broad, softly pubescent and ciliate. **Corolla** purple, pubescent outside, c. 6.7 cm long; tube 3 cm long; limb bilabiate, anterior lip monopetalous, deeply separated. **Stamens** 2 long fertile c. 2 cm long, with anthers linear, c. 4 mm long, 2 very small sterile, and posterior rudiment inserted c. 2 cm from the base of the corolla tube, hairy at base. **Ovary** glabrous; style c. 4.2 cm long, glabrous. **Capsule** compressed, blackish-green.

Thailand.— NORTHERN: Chiang Mai (Doi Chiangdao; Doi Angka; Doi Suthep; Omkoi); Chiang Rai (Maesai), Nan (Doi Phukha), Lampang (Muang Pan), Tak (Khao Phra Wo), Phitsanulok (Thung Salaengluang); NORTHEASTERN: Loei (Phu Luang); Sakonnakhon (Phu Phan), Phetchabun (Thung Salaengluang); SOUTHWESTERN: Kanchanaburi (Erawan National Park**;** Linthin; Tham Than Lot**),** Prachuap Khirikhan (Huai Yang Falls**)**

Distribution.— Thailand, Malaysia, Indonesia.

Ecology.— By stream, in evergreen jungle, 100-700 m. In bamboo forest, c. 750 m.

Vernacular.— Ra ngap (ระงับ), Ra ngap phit (ระงับพิษ), Yak am phaeng (หญ้ากำแพง) (Loei).

Note. — In natural habit, leaves much hairier and larger than cultivation.

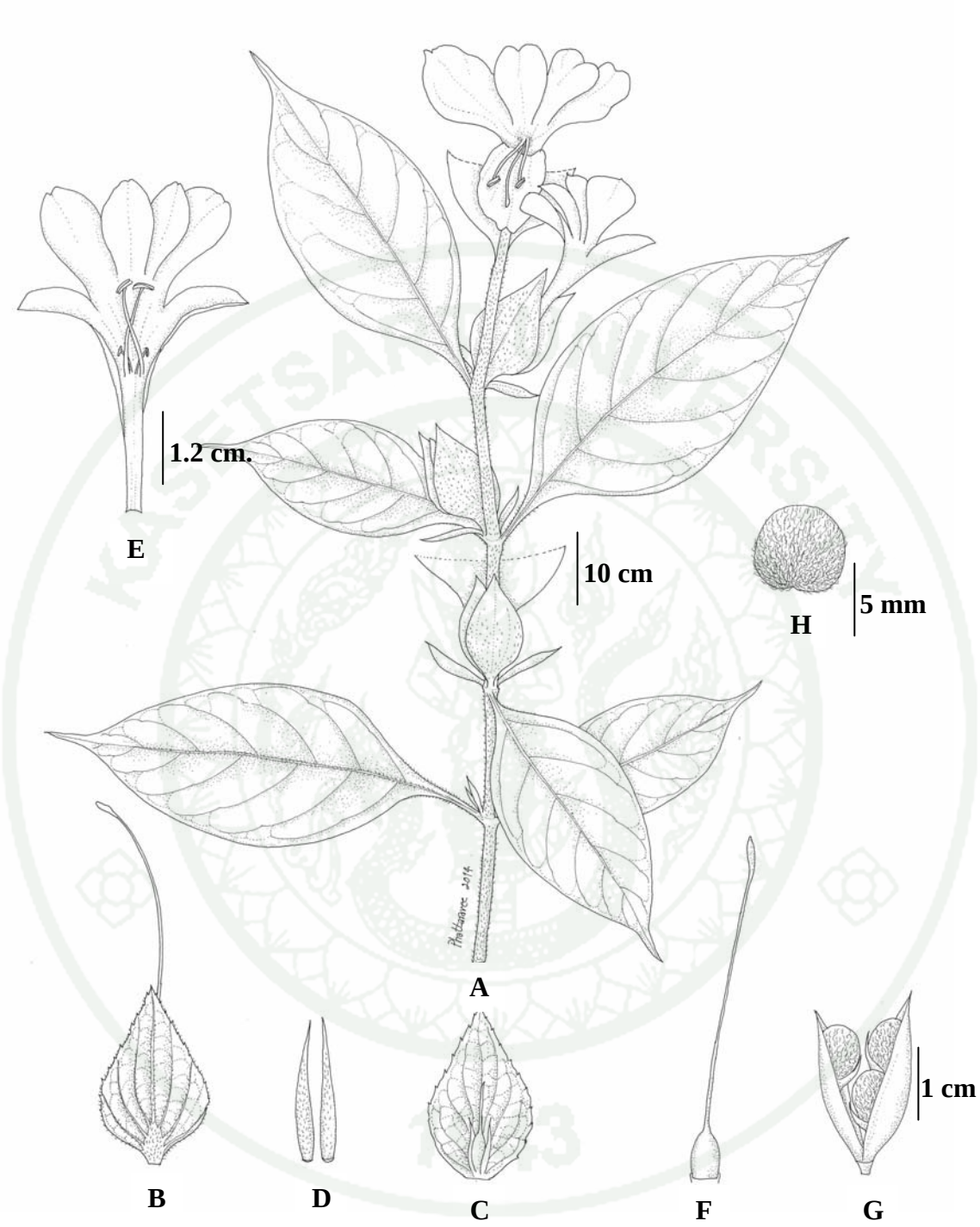

Figure 23 *Barleria siamensis*: A. habit; B. outer bract; C. inner bract; D. sepal; E. longtitudinal section of flower; F. Pistil; G. fruit; H. seed. Drawn by Phattaravee Phrommanat. All from Winai Somprasong 014040108-11 (BK)

6. Barleria strigosa Willd. *In* Sp. Pl. 379. 1803; Clarke *In* Fl. Br. Ind. 4: 482. 1885; Craib in Bull. Misc. Inform., Kew 1911: 437. 1911; Benoist *In* Gén. I.- C. 4: 686. 1935; Back. & Balkh. f., Fl. Java 2: 572.1965. Type from India. ── *Barleria coerulea* Roxb., Roxb., Fl. Ind. 3:39. 1832; Nees *In* Wall., Pl. As. Rar. 3: 89. 1832; Nees *In* DC., Prod. 11:226. 1847.

Erect shrub c. 0.3-1 m high,. Branchlets subterete, yellowish strigose-hirsute upwards especially on the young parts. **Leaves** ovate or ovate-elliptic, rarely obovate, acute rarely acute rarely obtuse at acute rarely obtuse at the apex, leaf base long attenuate, long decurrent on the petiole at the base, lineolate, glabrous above or sparsely strigose, nerves sparsely hairy below, 6-16 cm long or longer, 2-5 cm broad; midrib prominent below; lateral nerves 5-6 pairs, ascending, conspicuous below; transverse nerves many, more or less regular; margin subentire, slightly recurved, sparingly ciliate; petiole c. 5 cm long or absent. **Inflorescence** in dense spike, many-flowered, in 1-sided; axillary and terminal, unillateral, often glomerate, sepals imbricated; bracts imbricated along the underside of the spike, lanceolate, subacute, c. 1.2 cm long, c. 4 mm broad, nervosa, margin subentire, ciliate; bracteoles lanceolate or oblong, c. 1.6 cm long, 4-6 mm broad, the nerves sparsely hairy, margin denticulate ciliate. **Calyx**: outer sepals ovate, attenuate to the obtuse apex, nervosa, the nerves yellowish strigose, margin denticulate ciliate, posterior sepal c. 2.3 cm long, c. 1.5 cm broad, anterior sepal smaller, c. 2 cm long, c. 1.2 cm broad, usually shortly emarginated at the apex; lateral sepals linear, acute, 8-10 mm long, shortly ciliate. **Corolla** purple or pale purple, glandular-puberulous outside, 4-4.5 cm long; tube long, infundibuliform towards the apex; limb bilabiate, anterior lip monopetalous, shorter. **Stamens** 2 long fertile c. 1.7 cm long with oblong anthers c. 2.5 mm long, 2 very short with almost sterile anthers and a posterior rudiment inserted c. 2.3 cm from the base of the corolla tube, ciliate at the base. **Ovary** glabrous; style c. 3.8 cm long, glabrous. **Capsule** c. 1.8 cm long, glabrous, black, shining, 4-seeded to the apex.

Thailand. ──NORTHERN: Mae Hong Son (Pai , Tham Pla), Chiang Mai (Chiang Dao; Ban Aen; Mae Klang Falls; Mae Taeng); Chiang Rai (Doi Tung), Kamphaengphet (Ban Nam Tok), Lampang (Muang Pan Tham Pha Thai), Phitsanulok (Thung Salaeng Luang, Poi Falls), Uttaradit (Mohn Si Chaiw), Sukhothai (Muang Kao); NORTHEASTERN: Kalasin (Phu Phan), Khon Kaen, Loei (Phu Kradung; Phu Luang; Wangsaphung), Mukdahan (Dongman, Phu Hinthoep, Phu Mu), Nongkhai (Sangkhom, Si Chiangmai), Sakon Nakhon (Phu Phan); EASTERN: Buriram (Lam Plaimat), Chaiyaphum (Pa Huai Yai Chiu), Nakhon Ratchasima (Bua Yai; Pak Thong Chai, Sakaerat), Ubonratcha Thani (Muang Samsip, Nachaluai, Phibun Mangsahan); SOUTHWESTERN: Kanchana Buri (Erawan National Park ;Saiyok ;Si Sawat; Thong Phaphum); Phetchaburi (Kaeng Krachan), Prachuap Khirikhan (Huai Yang; Pranburi); CENTRAL: Chainat (Kao Tamnammon), Lopburi (Lamnarai), Saraburi (Phra Phutthabat, Na Phra Lan; Kaeng Khoi; Phukae; Samlan National Park; Hin Lap); SOUTHEASTERN: Chanthaburi (Khao Soi Dao), Chonburi (Siracha), Nakhon Nayok (Salika Falls), Prachinburi (Krabinburi, Ban Bung Hills), Sakaeo (Aranya Prathet); PENINSULAR: Chumphon (Khao Thalu ; Map Ammarit; Siepyuan; Ta Ngaw)

Ecology. ── In open evergreen and deciduous forest, 20 - 300 m.

Distribution.— India, Malaysia, Laos, Camcodia, Thaland.

Vernacular.— Sangkorani (สังกรณี) Tapping (ตับปิ้ง) Khifainokkhum (ขี้ไฟนกคุ้ม) (Sukhothai).

Uses. — Mature leaf boiled in water to be taken orally as a tonic. Whole plant used for curing gastrointestinal tract disease. Whole plant ground and applied for curing skin disease.

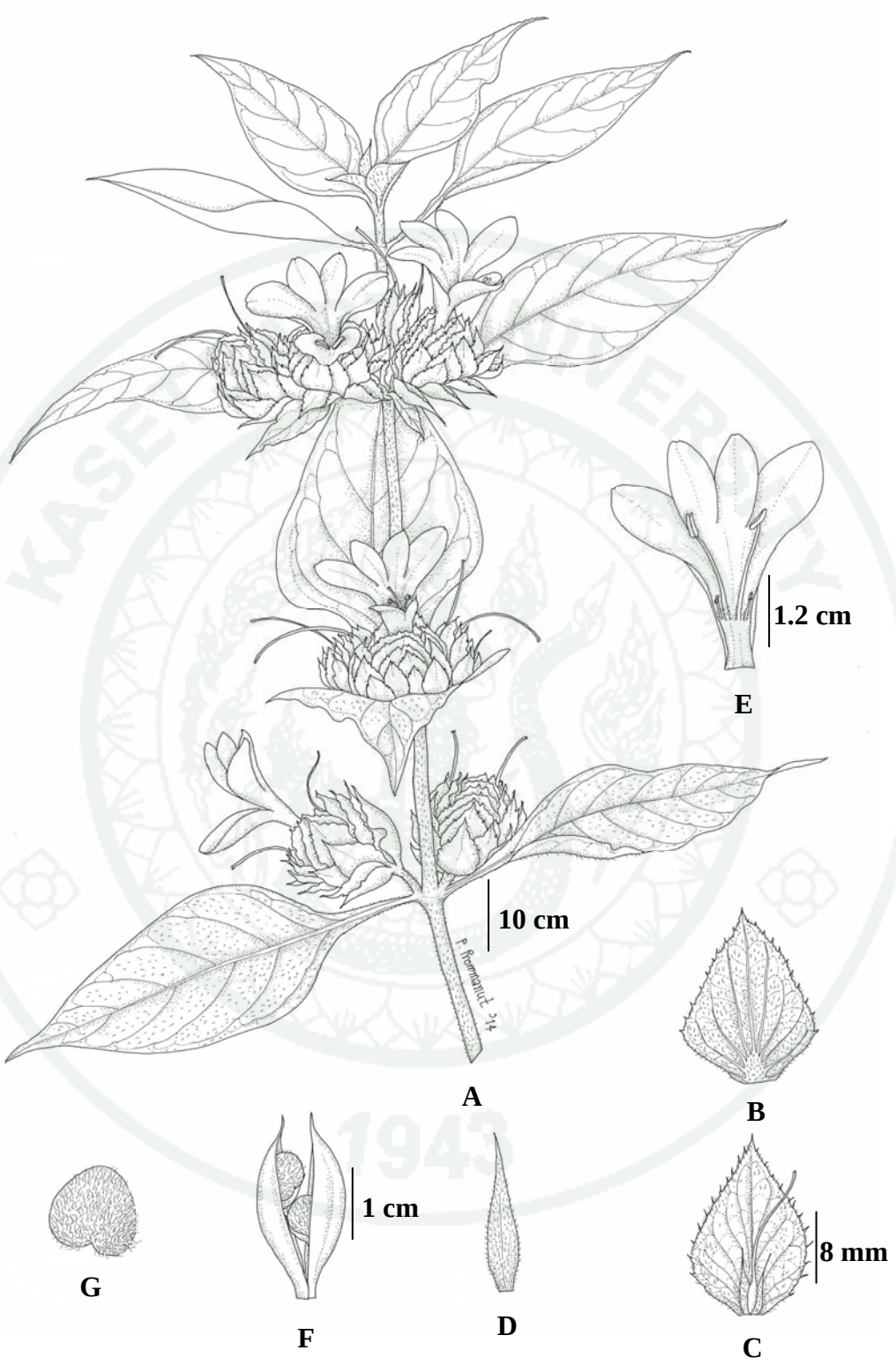

Figure 24 *Barleria strigosa*: A. habit; B. outer bract; C. inner bract; D. sepal; E. longtitudinal section of flower; F. fruit; G. seed. Drawn by Phattaravee Phrommanat. All from Winai Somprasong 014040108-10 (BK)

2. CHROESTHES

R. Ben. *In* Bull. Mus. Hist. Nat. (Paris) 33: 107. 1927; Léc., Fl. Gén. I.- C. 4: 684. 1935.

shrubs, subisophyllous or anisophyllous. **Leaves** opposite, petiolate; leaf blade margin entire. **Inflorescence** terminal thyrses; bracts and bracteoles greenish. Calyx unequally 5-lobed; posterior lobe largest, 2 lateral lobes smaller than 2 anterior lobes. **Corolla** tube basally cylindric and expanded distally into a throat; limb 2-lipped, lower lip 3-lobed, upper lip 2-lobed; lobes quincuncial in bud. **Stamens** 4, not connate, posterior pair shorter than anterior pair, inserted at base of throat; anthers 2-thecous; thecae parallel, inserted at different heights, dorsally pubescent, base spurred. **Ovary** with 2 ovules per locule; style basally sparsely pubescent. **Capsule** stipe absent or barely present; retinacula present. Seeds compressed, brownish pubescent.

Key to the species

1. Upper lips obtube, lower lip deeply incised, corolla white with spotted pink, lobe lanceolate, acute at the apex **1. *C. lanceolata***
1. Upper lips obtube, lower lip deeply incised, corolla pink with spotted red, lobe ovate-oblong, obtube at the apex **2. *C. bracteata***

1. Chroesthes bracteata (Imlay) B. Hansen in Nordic J. Bot. 3: 210. 1983.
—*Asystasia bracteata* Imlay [Siamese Acanth.: 311. 1938. sine deser. lat.] Kew Bull. 131. 1938. [Type: Kerr 17707 (ABD) lectotype; (C) isolectotype; (K) 2 isolectotypes)]

Shrub up to 3 m high. Branchlets subterete, glabrous. **Leaves** in subequal pairs, with petioles 1-2 cm long, lamina lanceolate 8-20 cm long, 2.5-7 cm broad, acuminate at the apex, shortly attenuate or cuneate at the base, glabrous on both surfaces; lateral nerves 8-9 pairs. **Infloerscence** in terminal thyrses, soliary or sometimes in pairs, 5-12 cm long; flowers opposite, uppermost solitary, the lower than the calyx, lanceolate, 2.8 cm long, 5-7 mm broad, attenuate at the base, acuminate at the apex, glandular-pubescent, midrib and latersl nerves conspicuous; bracteoles c. 1.5 cm long, 1-1.5 mm broad, linear-lanceolate, acuminate, glandular-pubescent, midrib conspicuous; pedicels 2-5 mm long, glandular-pubescent. **Calyx** 2-2.7 cm long, lobes linear-lanceolate, 1-2 mm broad, glandular-pubescent outside, pubescent inside, longitudinally nerved. **Corolla** bilabiate, pale pink, spotted red, c. 3 cm long, pubescent outside, some hairs glandular; narrow part of the tube 1 cm long, hairy inside at the apex, inflated part c. 1.4 cm long, glabrous inside, Upper lips obtube, lower lip deeply incised, corolla white with spotted pink, lobe lanceolate, acute at the apex; the 2 posterior lobes united at the base for about half their length. **Stamens** 4, inserted at the base of the inflated part of the corolla; filaments 8 and 10 mm long, glabrous; anthers shortly hairy along the back and at the apex, bicalcarate at the base. **Ovary** glabrous; style c. 2 cm long, with a few hairs near the base. **Capsule** c. 2 cm long, oblong-elliptic, glabrous. Seeds, flattened, almost orbicular, very shortly hairy, 4-seeded.

Thailand.— SOUTHEASTERN: Trat (Khao Kuap).

Distribution. — Peninsular Thailand.

Ecology. —Shaded, in evergreen forest, 400-600 m.

2. Chroesthes lanceolata (T. And.) B. Hansen *In* Nordic J. Bot. 3: 209. 1983**.** —*Asystasia lanceolata* T. And., J. Linn. Soc., Bot. 9:524.1867; C.B.Cl. *In* Hook, g., Fl. Br. Ind. 4: 495. 1884. —*Asystasia kerrii* Craib, Kew Bull. 1911: 438., Benoist in Fl. Gén, I. – C. 4: 714. 1935: Imlay, Siamese Acanth. : 310. 1938. —Type: Kerr 537 (K lectotype, isolectotype), Kerr 1042 (K paratypes), — *Asystasia silvicola* W.W. Sm., Notes Roy. Bot. Gard. Edin-burgh 10: 170. 1918. — *Chroesthes silvicola* (W.W. Sm.) E. Hossain, Notes Roy. Bot. Gard. Edinburgh 32: 405. 1973. Type: Henry 12934 (E lectotype, isolectotype, K 2 isolecto – types), Henry 11600A (AAH, E, K paratypes), — *Chroesthes pubiflora* R. Ben., Bull. Mus. Hist. Nat. (Paris) 33: 107. 1927; *In* Fl. Gén. I.-C. 4: 684. 1935. – Type: H.d'Or-leans s.n. (P syntype), Bons d'Anty s.n., (K, P. syntypes).— *Chroesthes racemiflora* Brem., Dansk Bot. Ark. 20: 73. 1961 incl. var. *glabrior* Brem., ibid: 74. —Type:Sorensen, Larsen & Hansen 6865 (C holotype, BKF isotype) ; Type of var. : Soren-sen, Larsen & Hansen 1718 (C holotype; AAH, E isotypes).

Shrub 0.5-3 m high, Branchlets terete, glabrescent. **Leaves** in unequal pairs, with petioles 0.5-2 cm long, lamina elliptic-lanceolate to lanceolate 5-21 long, 1.5-8.5 cm broad, attenuate or cuneate at the base, shortly acuminate at the acute apex, glabrous or pubescent on nerves be-low; lateral nerves 6-9 paris. **Inflorescence** in terminal thyrse, 3.5-8 cm long; flowers opposite or the lower ones 2-3 together in cymes; bracts oblong-lanceolate or broadly lanceolate 3-9 mm long, 1-3 mm broad, shortly acuminate at the apex, midrib and lateral nerves conspicuous, glandular-pubescent; bracteoles similar to the bracts but smaller, 4-9 mm long, 0.75-1.25 mm broad; pedicels 1-5 mm long. **Calyx** 1-1.6 cm long, glandular-pubescent outside and pubescent inside, lobes subequal, the posterior one lanceolate and broader, the lateral ones linear-acuminate and the anterior ones slightly broader, 1-1.5 mm broad, conspicuously nerved, the anterior lobes sometimes more or less united up to ⅔ of their length. **Corolla** bilabiate, white, spotted pink to purple, 2.5-3 cm long, pubescent outside ; narrow part of the tube c. 9 mm long, inflated part c. 1.5 cm long, glabrous inside; the 2 posterior lobes united at the base for about half their length, the 3 anterior ones free. **Stamens** 4, inserted at the base of the inflated part of the corolla; filaments 1-1.2 cm long, glabrous; anthers shortly hairy along the sides and at the apes, bicalcarate at the base. **Ovary** hairy at the apex; style 2.5 cm long, pubescent from the base. **Capsule** 1.2-1.6 cm long, oblong, minutely pubescent at the apex only or glabrous. Seeds, flattened, orbicular, very shortly hairy, 4-seeded.

Thailand.—NORTHERN: Chiang Mai (Doi Sutep; Chiang Dao).

Distribution. —South China, Thailand, Laos, Vietnam.

Ecology.— In the crevices by stream in evergreen forest, 300 – 700 m.

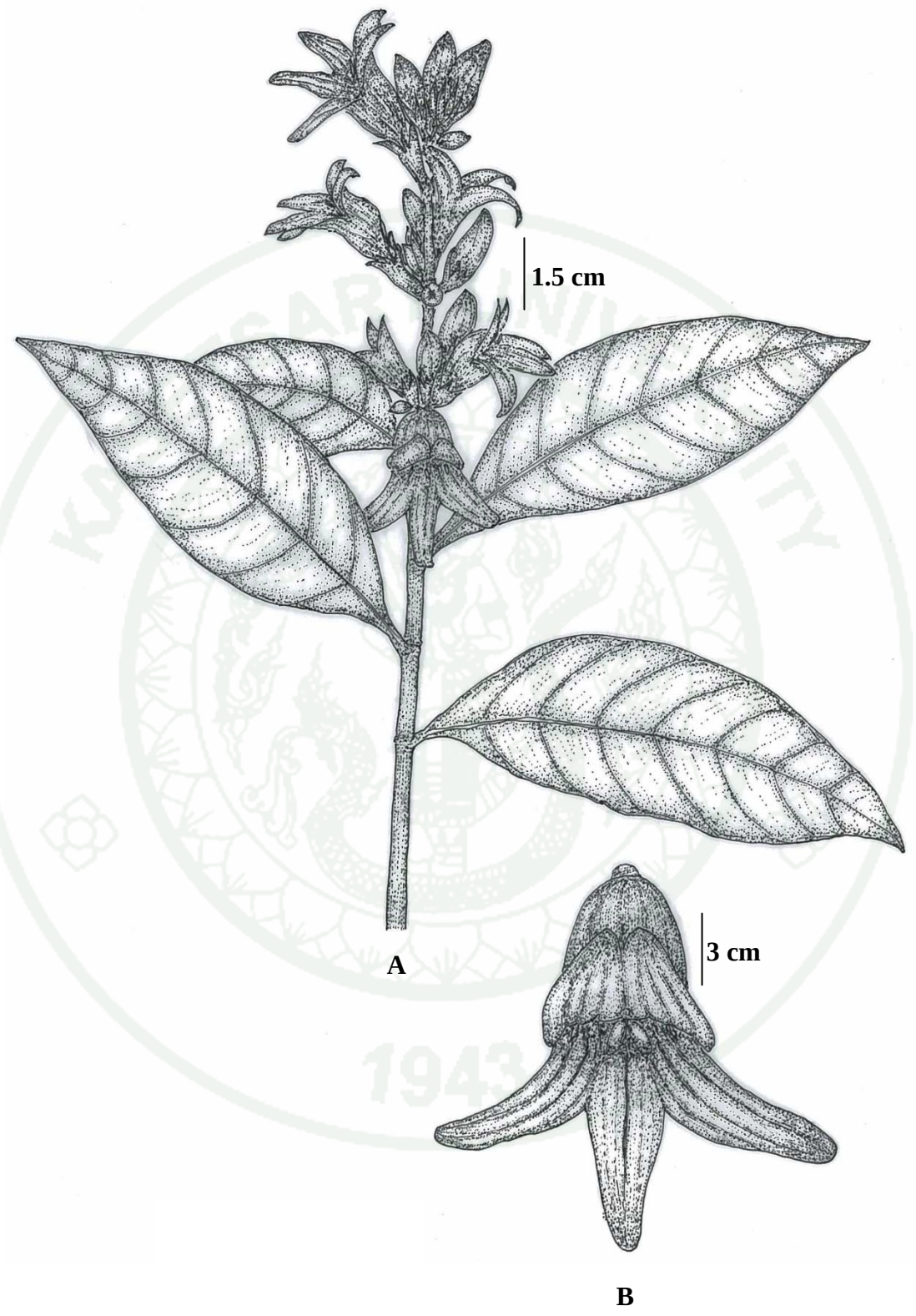

Figure 25 *Chroesthes lanceolata*: A. habit; B. flower. Drawn by Jessada Tengrang. All from Winai Somprasong 013070154-1

2. LEPIDAGATHIS

Willd., Sp. Pl. 3: 400 (1802); Nees *In* Wall., Pl. As. Rar. 3:76 & 95. 1832; Nees in DC., Prod. 11: 249. 1847; Benth. & Hook.f., Gen. Pl. 2:1101. 1867; Type species: *Lepidagathis cristata* Willd.

Herbs or undershrubs, erect, prostrate or diffuse, unarmend or with the bracts spinescent. **Leaves** opposite, often in uneual pairs, petiolate or sessile, entire or crenate-serrate. **Inflorescence**: axillary and terminal spikes, dense or rarely interrupted, solitary, paired or grouped, globose, oblong or elongated, usually unilateral; bracts 1-flowered, mostly imbricated, 4-ranked, of which 2 ranks are sterile, rarely shorter than the calyx; bracteoles 2. **Calyx** 5-partite, often scarious; sepals unequal, the posterior the largest, the 2 anterior sepals free, or connate from the base, the 2 lateral sepals interior, much smaller, linear. **Corolla** tube narrow at the base, suddenly ventricose from the middle; limb bilabiate, the upper lip erect or spreading, emarginated or shortly 2-fid, the lower lip spreading, shortly 3-lobed; lobes subequal, imbricated in the bud. **Stamens** 4, didynamous, inserted below the throat of the corolla; filaments included, the posterior shorter; posterior anthers 1 or 2- locular, anterior anthers both 2-locular, loculi parallel or divergent, muticous, subequal, one sometimes a little higher than the other. **Ovary** bilocular, 2-4 ovuled; dise very small, annular; style capitellate and minutely bifid or entire at the apex. **Capsule** oblong, acute at the spex, seed-bearinging from the base. Seeds 4, or fewer by abortion, sub-orbicular or ovate, flattened, hairy, borne on stout curved jaculators.

About 100 species from tropical Africa, Asia and two from America. 7 species are enumerated from Thailand.

Key to the species

1.Posterior stamens with unilocular anthers; bracts 5-nerved:
  2. Two anterior sepals united at the base for at least ¼ their length; plant erect, not rooting at the lower nodes:
    3. Anterior sepals united at the base c. 3/4 their length; Petiole c. 2 cm long **4. L. falcata**
    3. Anterior sepals united at the base for c. 1/4 their length; Leaves subsessile **3. L. dissimilis**
  2.Two anterior sepals free to the base; plant diffuse, often prostrate and rooting at the lower nodes **7. L. purpuricaulis**
1.Posterior and anterior stamens with bilocular anthers; bracts 1-3 nerved;
  4.Anterior sepals free to the base:
    5.Bracts 1-nerved, lanceolate-acuminate; spikes oblong; leaves entire or subentire or crenulate
      6. posterior sepal narrow lanceolate, spinescent **2. L. chlorostachya**
      6. posterior sepal lanceolate acute, not spinescent **1. L. chiengmaiensis**
    5.Bracts 3-nerved, ovate or elliptic, acute; spikes Ovate; leaves crenate-serrate towards the apex **6. L. incurva**
  4. Anterior sepals united at the base for c. 1/3 their length **5. L. fasciculata**

1. Lepidagathis chiengmaiensis Brem., Dansk Bot. Ark 20: 72. 1961.
—*Lepidagathis parviflora* R. Ben. *In* Fl. Gén.I.- C. 4: 694, 1935.

Herb, decumbent, up to 0.5 m high. Stems quadrangular, slender, pubescent or glabrescent, often glandular. **Leaves**, ovate, or ovate-oblong, shortly acuminate to the subacute apex, attenuate at the base, pubescent on both surfaces, 1.5-3 cm long, 0.8-1.8 cm broad; midrib conspicuous above, prominent below; lateral nerves 5-6 pairs, conspicuous on both surfaces; base contract, apex acute, discolor; petiole c. 0.3 cm long. **Inflorescence** in spike, binate, axillary and terminal, subglobose, secund, 1-1.5 cm long, sessile or pedunculate, interrupted towards the base with the lower flowers in opposite pairs; peduncles sometimes longer than the leaves, but usually c. 5 mm long, villous and glandular; sterile bracts elliptic, acute, 3-nerved, glandular pubescent, ciliate, 8-10 mm long, c. 1.2 mm broad; fertile bracts lanceolate, acute, similar c. 7 mm long, c. 2 mm broad; Brateoles similar to bracts, c. 1.5 mm broad; **Calyx** 5, c. 73 mm long, posterior sepal lanceolate acute, 1-nerved, c. 7.3 mm long, c. 1 mm broad; 2 anterior sepals free almost to the base, oblong acute, 1-nerved, c. 6.5 mm. long, c. 0.5 mm broad; 2 lateral sepals setaceous, 1-nerved, 5.5 mm long, ca. 0.3 mm. broad, all glandular-ciliate. **Corolla** yellowish red, c. 10 mm long; tube narrow, c. 4.5 mm long, campanulate, constrited near the base; upper lip shorter, ovate, c. 3 mm. long, c. 2.5 mm broad, 6-nerved; lower lip 3-lobed, c. 2 mm long, c. 3 mm broad, the lobes oblong deltoid, the median lobe a little broader and longer. **Stamens** inserted near the base of the corolla; posterior filaments shorter, c. 0.7 mm long, the anterior c. 3 mm long; anthers bitheca. **Ovary** glabrous; style c. 5 mm long, puberulous at the base; Styles, glabrous, c. 5 mm long. **Capsule** not seen.

Thailand.— NORTHERN: Chiang Rai.

Distribution.— Thailand.

Ecology. — Weed, c. 400 m.

2. Lepidagathis chlorostachya Nees *In* DC. Prodr. 11: 256. 1847; T. Anders in Journ. Linn. Soc. 9: 496. 1867; C.B. Clarke in Hook. F. Fl. Brit. Ind. 4: 519. 1884.

Shrub erect, c. 0.5 m high. Branchlets quadrangular, becoming cylindrical, almost glabrous. **Leaves** large, petiolate, subequal, elliptic, acuminate at both ends, glabrous, shining, lineolate on both surfaces, 10-18 cm long, 4-7 cm broad; midrib conspicuous above, prominent below; lateral nerves 9-10 pairs, conspicuous above, prominulent below, uppermost nerves linked within the margin, transverse nerves many, parallel; margin subentire or crenulate; petiole 1.5 – cm long. **Inflorescence** in axillary and terminal spike, subsessile, erect, secund, densely ciliate, c. 5 cm long, solitary, sometimes 2 together; sterile bracts alternate, lanceolate acute, c. 8 mm long, c. 2 mm broad, 1-nerved, glabrous on both surfaces, margin ciliate with long and short hairs; fertile bracts lanceolate acute, 8 mm. long, c. 2 mm broad, lower nerves minutely puberulous, sometimes glandular, margin as above; bracteoles similar but a little smaller. **Calyx** glabrous outside except the nerves pubescent; 2 anterior sepals free to the base, narrow oblong, spinescent, c. 9 mm long, c. 0.5 broad, 1-nerved;

posterior sepal narrow lanceolate, spinescent, c. 9 mm long, c. 1.5 mm broad; lateral sepals linear acute, c. 7 mm long, 1-nerved, all white ciliate. **Corolla** yellow with purple spots on lower lip, c.1.2 cm long, pubescent outside towards the apex only; tube constricted near the base, pilose inside at the base of the stamens; upper lip rounded, very shortly 2-lobed, lower lip 3-lobed, the lobes oblong tapering obtuse. **Stamens** inserted near the base of the corolla tube; anterior filaments 3 mm long, with bilocular anthers; posterior filaments c. 2 mm long, with anthers bilocular. **Ovary** white hairy at the apex; style c. 8 mm long, pubescent near the base. **Capsule** not seen.

Thailand.— PENINSULAR: Chumphon (Ta Ngaw; Ta San), Krabi (Ao Luek ; Nai Chong), Nakhon Si Thammarat (Kung Ching Water Falls) Ranong (Kra Buri ; Punyapan Falls ; Rak Warin Falls), Surat Thani (Khao Sok; Khirirat Nikhom; Phanom; Yan Yao).

Distribution.— Myanmar, Peninsular Thailand.

Ecology. — In evergreen forest at foot of limestone hill, 50-100 m.

3. Lepidagathis dissimilis J.B. Imlay *In* Bull. Misc. Inform. Kew. 125. 1939.

Herb or undershrub, c. 30 cm high. Branchlets obtusely quadrangular, pubescent, the hairs curving upwards and sub-appressed, densely lineolate. **Leaves** subsessile, subequal, elliptic or elliptic-lanceolate, subacute at the apex, attenuate at the base, coriaceous, lineolate above and below, almost glabrous above and pilose on the nerves below, 5- 8.5 cm long, 2-3.5 cm broad; midrib and 5-6 pairs lateral nerves conspicuous above, prominent below; transverse nerves obscure; margin subentire, recurved; petiole 2-3 mm long. **Inflorescence** in spike, unilateral, solitary, axillary and terminal, solitary or 2-3 together, subsessile, dense, oblong, 2.5-5 cm long; 2.5 cm broad; sterile bracts lanceolate, or falcate, acute, sessile, obliquely attached to the axis, c. 1.5 cm long, c. 4 mm broad, conspicuously 5-nerved, glabrous except margin sparingly ciliate; fertile bracts 1-flowered, oblong acuminate,scarious, otherwise similar to the sterile bracts; bracteoles linear-lanceolate, glabrous green, 1.3 cm long 2 mm broad. **Calyx** 1.3 cm long, glabrous, scarious; 2 anterior sepals united at the base for c. ¼ their length, 2- nerved, oblong acuminate, c. 1.2 cm long, 2 mm broad, posterior sepal oblong acuminate, c. 1.3 cm long, 3.5 mm broad, 3-5 nerved, margin sparingly ciliate. **Corolla** white with purple markings, glabrous outside, 10 mm. long tube widening from just above the base; pilose inside; lower lip 3- lobed, the lobes oblong and rounded, 1.5 – 2 mm long, upper lip truncate, scarcely bilobed. Stamens inserted near the base of the corolla tube; anterior filments c. 4.5 mm long, glabrous, with anthers c. 1 mm long and bilocular, posterior filaments c. 3 mm long, with anthers uniloculler **Ovary** glabrous; style c. 7 mm long, puberulous at the base. **Capsule** c. 8 mm long, glabrous. Seed, round, flattened, hairy, 4-seeded.

Thailand. —NORTHERN: Sukhothai (Muang Kao); NORTHEASTERN: Mukdahan (Dong Man); EASTERN: Chaiyaphum (Khao Hong); SOUTHEASTERN: Sa Kaeo (Aranya Prathet).

Vernacular. — Ya thong Pling (หญ้าท้องปลิง), Ya Ta Khap (หญ้าตะขาบ) (Sukhothai).

Ecology.— Among grasses in decisuous forest, c. 100 m.

4. Lepidagathis falcata Nees *In* Wall. Pl. As. Rar. 3: 96. 1832; Nees Monogr. *Lepidagathis* 28. 1841; Nees *In* DC. Prodr. 11: 249. 1847; T. Anders in Journ. Linn. Soc. 9: 496. 1867; R. Ben. *In* Lec. Fl. Gén. I.- C. 4: 690. 1935.

Small shrub, up to 40 cm high, quadrangular, becoming cylindrical densely lineolate, pilose at the nodes. **Leaves** unequal, petiolate, ovate, acuminate to the acute apex, alternate at the base and decurrent on the petiole, chartaceous, lineolate on both surfaces, sparingly pubescent above towards the margin, and on the nerves below; midrib and 6-7 pairs lateral nerves conspicuous above, prominent below; transverse nerves obscure; margin entire, pubescently ciliate; petiole c. 2 m long. **Inflorescence** in axillary and terminal spike, sessile, solitary or paired, unilateral, 1.5 – 6 cm long, almost glabrous; sterile bracts lanceolate, obliquely spinous-acuminate at the apex c. 1.5 m long, c. 4 mm broad, 5-7 nerved, glabrous, margin mimtely ciliate; fertile bracts scarious, oblong-lanceolate, spins acuminate, 1.4 cm long, c. 4 mm broad, 5- nerved and reticulate, otherwise as the sterile bracts; bracteoles line lanceolate, c. 1.2 cm long, c. 3 mm broad, 3 nerved. **Calyx** c. 1.5 cm long, glabrous outside, scarious; 2 anterior sepals united from the base for ¾ their length, c. 1.3 cm long, c. 6 mm broad, spinous-acute, longitudinally nerved, posterior sopal broadly lanceolate, spinous-acute, c. 1.5 cm long, c. 5 mm broad, longitudinally nerved, 2 lateral sepals linear acute, 1-nerved, c. 9 mm long. **Corolla** white with purple markings, glabrous outside, 1.4 cm long; tube constricted near the base, hairy inside; upper lip truncate, subentire, lower lip 3-lobed, the lobes oblong obtuse, c. 2 mm long, median lobe a little shorter and broader. **Stamens** inserted c. 5 mm from the base of the corolla tube, posterior filaments c. 3 mm long with unilocular anthers c. 1 mm long, anterior filaments c. 5 mm long with bilocular anthers, 1-celled, a little above the other. **Ovary** glabrous; style c. 10 mm long, puberulous. **Capsule** ovoid.

Thailand. — NORTHERN: Mae Hong Son (Tham Pla), Tak (Bhumibol Dam); NORTHEASTERN: Sakon Nakhon (Phu Phan); PENINSULAR: Ranong (Kra Buri).

Distribution. — Myanmar, Indonesia, Thailand.

Ecology. — In bamboo forest, 100-400 m. In evergreen forest, 400-600 m.

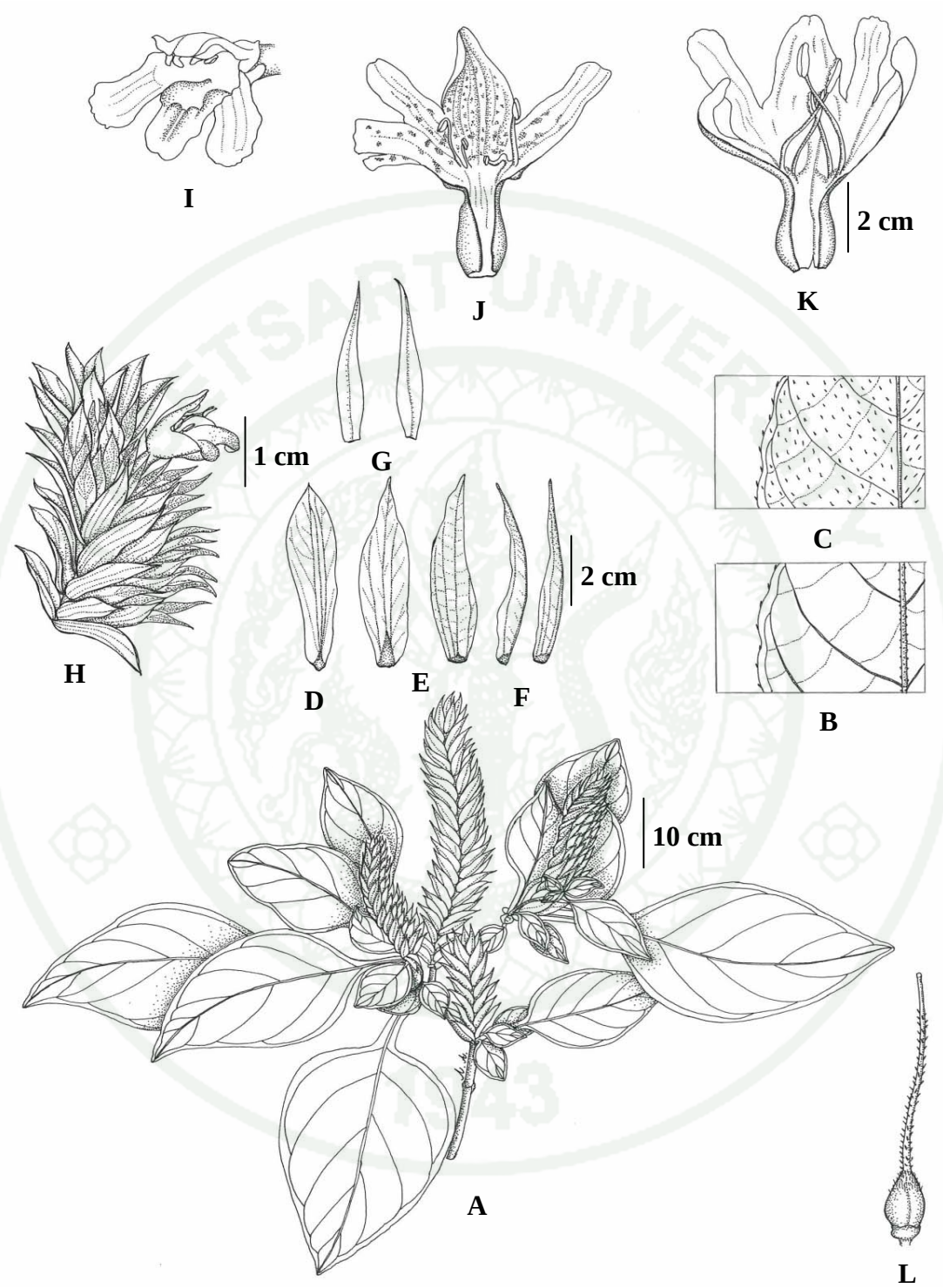

Figure 26 *Lepidagathis falcata*: A. habit; B. the adaxial of leaf; C. the adaxial of leaf; D. bract; E. posterior sepal; F. anterior sepal; G. lateral sepal; H. bract arrangement; I. flower; j. longtitudinal section of flower; K. stamen arrangement; L. pistil. Drawn by Nongnoot Anuraktrakoon.
All from Winai Somprasong 016090112-3 (BK)

5. Lepidagathis fasciculata (Retz.) Nees *In* Wall. Pl. As. Rar. 3: 95. 1832; Nees Monogr. *Lepidagathis* 10. 1841; Nees in DC. Prodr. 11: 260. 1847; T. Anders. *In* Journ. Linn Soc. 9: 498. 1867; C.B. Clarke In Hook. F. Fl. Brit. Ind. 4: 522. 1884; R. Ben. *In* Lec. Fl. Gen. I.- C. 4: 692. 1935. —*Ruellia fasciculata* Retz. Obs. 4: 28. 1786; Vahl Symb. Bot. 3: 82. 1794; Willd. Sp. Pl. 3: 369. 1801; Roxb. Fl. Ind. 3: 48. 1832. L. hirta Nees Mongr. *Lepidagathis* 37. 1841. L. Goensis Dals; in Hook. Kew Journ. Bot. 2: 340. 1850.

Herb, diffuse, up to 0.5 m high. Stems quadrangular, slender, villous, the hairs spreading, often glandular. **Leaves** petiolate, ovate, ovate-lanceolate, or ovate-oblong, shortly acuminate to the subacute apex, attenuate at the base, villous-pubescent on both surfaces, or at least on the nerves below, 4-9.5 cm long, 1.8-4 cm broad; midrib conspicuous above, prominent below; lateral nerves 5-6 pairs, conspicuous on both surfaces; margin sinuate-dentate towarda the apex; petiole 6-10 cm long. **Inflorescence** in axillary and terminal spike, subglobose, secund, 8-10 m long sessile or pedunculate, interrupted towards the base with the lower flowers in opposite pairs; peduncles sometimes longer than the leaves, but usually c. 5 mm long, villous and glandular; sterile bracts ovate-elliptic, acute, 3-nerved, glandular pubescent, ciliate, 8-10 mm long, 3-4 mm broad; fertile bracts elliptic, acute, similar but a little smaller, 5-7 mm long; bracteoles linear, acute, unequal, villous, glandular. **Calyx** c. 7 mm long; posterior sepal lanceolate acute, 3-nerved; 2 anterior sepals free almost to the base, oblong acute, 1-nerved; 2 lateral sepals setaceous, 1-nerved, c. 5 mm long, all glandular-ciliate. **Corolla** white with pink or purple markings, c. 9 mm long; tube narrow, constrited near the base; upper lip shorter, rounded, very shortly emarginated at the apex; lower lip 3-lobed, the lobes oblong rounded, the median lobe a little broader and longer. **Stamens** inserted near the base of the corolla; posterior filaments shorter, c. 1.5 mm long, the anterior c. 3 mm long; anthers all bilocular. **Ovary** pubescent; style c. 5 mm long, puberulous at the base. **Capsule** c. 5 mm long, minutely pubescent towards the apex.

Thailand.— NORTHERN: Chiang Mai (Nong Hoi; Suan Song Saen), Chiang Rai (Muang), Lampang (Pang Pue), Phrae (Huai Rong; Ridge between Phrae and Uttaradit; Song), Nakhon Sawan (Lat Yao); NORTHEASTERN: Loei (Phu Luang), Kalasin (Somdet); EASTERN: Nakhon Ratchasima (Pak Chong); SOUTHWESTERN: Kanchana Buri (Sangkhlaburi); SOUTHEASTERN: Nakhon Nayok (Khao Noi); PENINSULAR: Phangnga (Thap Put), Satun (Tarutao Island), Lampang (Pang Pui)

Distribution. — India, Sri Lanka, Myanmar, Laos, Thailand.

Ecology. — By stream in mixed and deciduous forest, c. 200-600 m., in evergreen forest, 60 – 200 m.

6. Lepidagathis incurva Ham. ex D. Don., *In* Prodr. Fl. Nep. 119. 1825; Kurz in Flora 3: 363. 1870; C.B. Clarke in Journ. As. Soc. Beng. 124: 672. 1908; Hosseus in Engl. Bot. Jahrb. 12. 1908; Craib in Kew Bull. 439. 1911; Ridley Fl. Mal. Pen. 2: 586. 1923; R. Ben., In Lec. Fl. Gén. I.- C. 4: 691. 1935; Wall. Cat. 2365.

— *Lepidagathis hyalina* Nees *In* Well. Pl. As. Rar. 3: 95. 1932; Nees in DC. Prodr. 11: 252. 1847; T. Anders. In Journ. Linn. Soc. 9: 498. 1867, C.B. Clarke in Hook. F. Fl. Brit. Ind. 4: 498. 1867, C.B. Clarke in Hook. F. Fl. Brit. Ind. 4: 521. 1884; Lindau in Engl. And Pratl. Nat. Pflanzenf. 4: 3b 313. 1895. — *Lepidagathis cephalotes* O. Kuntze Rev. Gen. 2: 492. 1891. —*Lepidagathis parviflora* Blume, Craib in Kew Bull. 439. 1911. Siam material only. —*Ruellia dependens* Roxb. Fl. Ind. 3: 49. 1832.

Herb diffuse, c. 1 m high. Stems quadrangular when yound, becoming cylindrical later, shortly pilose or almost glabrous. **Leaves** in unequal pairs, petiolate, ovate or lanceolate, acuminate to the acute apex, long decurrent at the base, lineolate and pubescent, often pilose, on both surfaces, the older leaves becoming glabrous, 2.5 – 13 cm long, 1.5-6 cm broad; midrib conspicuous above, prominent below; lateral nerves 6-7 pairs, conspicuous on both surfaces, ascending; margin subantire or undulate, slightly recurved; petiole 1-2 cm long or less. **Inflorescence** in dense spike, ovoid cylindrical or oblong, terminal and in the upper axils, solitary or, more usually, branched at the base, 1-sided, softly pilose and ciliate, 1-4 cm. long; bracts 4-ranked, lanceolate acute or acuminate, mucronate, 7-10 mm long, c. 2 mm broad, 1-nerved, softly long ciliate; bracteoles linear-lanceolate, 7 mm long, 1-nerved, ciliate. **Calyx** 8 mm long; posterior sepal lanceolate, acuminate, mucronate, c. 8 mm long, 2 mm broad, 1-nerved, ciliate; 2 anterior sepals lanceolate, acuminate, c. 7 mm long united at the base for about 1/3 their length; 2 lateral sepals linear acuminate, c. 5 mm long. **Corolla** white with pink markings, pubescent outside, c. 10 mm long; tube narrow at the base for c. 4 mm; upper lip rounded and emarginated at the apex; lower lip with 3 oblong rounded lobes. **Stamens** inserted near the base of the corolla; posterior filaments shorter, all anthers bilocular. **Ovary** pubescent at the apex; style almost glabrous. **Capsule** c. 5 mm long, pubescent at the apex, 4-seeded.

Thailand. —NORTHERN: Chiang Mai (Chiangdao; Doi Changkian; Doi Pui; Hot; Mae Chaem), Chiang Rai (Huai Hin Fon; Muang), Lampang (Doi Khun Tan; Chae Hom), Tak (Krabak Yai National Park; Mae Tho; Mae Sot), Phitsanulok (Thung Salaeng Luang); NORTHEASTERN: Khon Kaen (Chumphae), Loei (Phu Luang; Phu Kradung), Sakon Nakhon (Phu Phan); EASTERN: Chaiyaphum (Thung Kramang), Nakhon Ratsasima (Pak Chong); SOUTHWESTERN: Kanchana Buri (Saiyok), Uthai Thani (Ban Rai); CENTRAL: Bangkok (Khlong San), (Saraburi, Samlan Forest); SOUTHEASTERN: Chanthaburi; PENINSULAR: Nakhon Si Thammrat (Thung Song), Pattani (Bannang Star);

Distribution. —India, Myanmar, Malay Peninsula, Indonesia, Laos, Cambodia, Southern China, Taiwan.

Ecology. —In evergreen forest, 800-1500 m. In scrub jungle on bank of river, 30- 50 m.

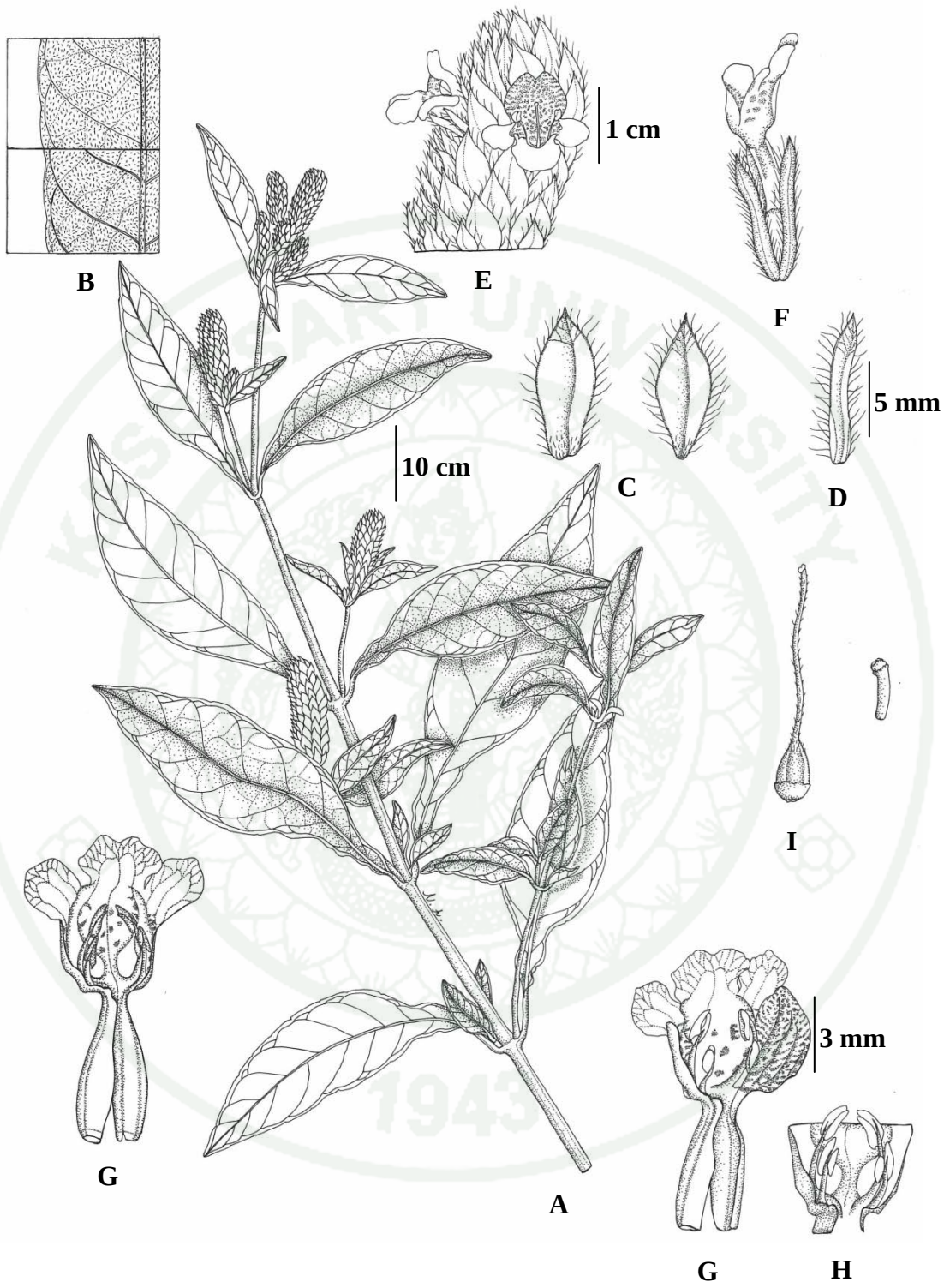

Figure 27 *Lepidagathis incurva*: A. habit; B. the adaxial leaf; C. bract; D. bracteole; E. bract arrangement; F. flower; G. longtitudinal section of flower; H. stamen; I. pistil. Drawn by Nongnoot Anuraktrakoon. All from Winai Somprasong 052070112-3 (BK)

7. Lepidagathis purpuricaulis Nees *In* Wall. Pl. As. Rar. 3: 96. 1832; Nees Monogr. *Lepidagathis* 27. 1841; T. Anders *In* Journ. Linn.Soc. 9: 496. 1867; C.B. Clarke in Hook f. Fl. Brit. Ind. 4: 519. 1884; R. Ben *In* Lec. Fl. Gén. I.- C. 4: 689. 1935.
—*Lepidagathis striata,* Nees *In* Wall. Pl. As. Rar. 3: 96. 1832; Wall. Cat. 7165.
—*Ruellia mucronata* Wall. Cat. 2366

Herb, diffuse or erect, c. 0.5 m high Stems quadrangular, glabrous or pubescent, often purple. **Leaves** sometimes uneqal, lanceolate or ovate-lanceolate, acuminate to the acute apex, attenuate at the base, thinly chartaceous, lineolate, pubescent at firest, becoming glabrous, 1.5 – 12 cm long, 0.6-3 cm broad; midrib and 7 pairs lateral nerves conspicuous above, prominent below, the lateral nerves ascending; transverse nerves many, prpallel; margin entire; petiole 1 cm. long or less. **Infloescence** in axillary spike, sessile, solitary, often 1-2 branched at the base, oblong, hairy, 2-3 cm long; bracts 4-ranked lanceolate, acute, c. 8 mm long, c. 2 mm broad, 5-nerved, pubescent on the nerves, ciliate; bracteoles scarious, linear, acute, 3-nerved, 7-8 m long. **Calyx** hairy outside, c. 11 mm long; posterior sepal lanceolate, acute, 5-nerved and reticulate, c. 11 mm long; c. 2.5 mm broad; 2 anterior sepals free almost to the base, linear acute, 3-nerved, c. 9 mm long, c. 1 mm. broad at the base; lateral sepals narrow linear, acute, 1-nerved, c. 7 mm long, c. 0.5 mm broad, all ciliate with long and short hairs, often glandular when yound. **Corolla** white with violet spots on lip, c. 11 cm long, pubescent outside at the tip; tube cylindrical at the base; upper lip emarginated; lower lip 3-lobed, the median lobe larger. **Stamens** inserted about the middle of the corolla; posterior filaments shorter, c. 2 mm long, with unilocular anthers; antherior filaments 3 mm long, with bilocular anthers. **Ovary** pubescent at the apex; style hairy at the base. **Capsule** c. 6 mm. long, oblong acuminate, pubescent towards the apex.

Thailand.— NORTHERN: Lampang (Wang Nua), Phisanulok (Thung Salaeng Luang).

Distribution. — Southern Himalaya, Myanmar, Vietnam, Thailand.

Ecology. — By stream, in evergreen jungle by atream, c. 450 m.

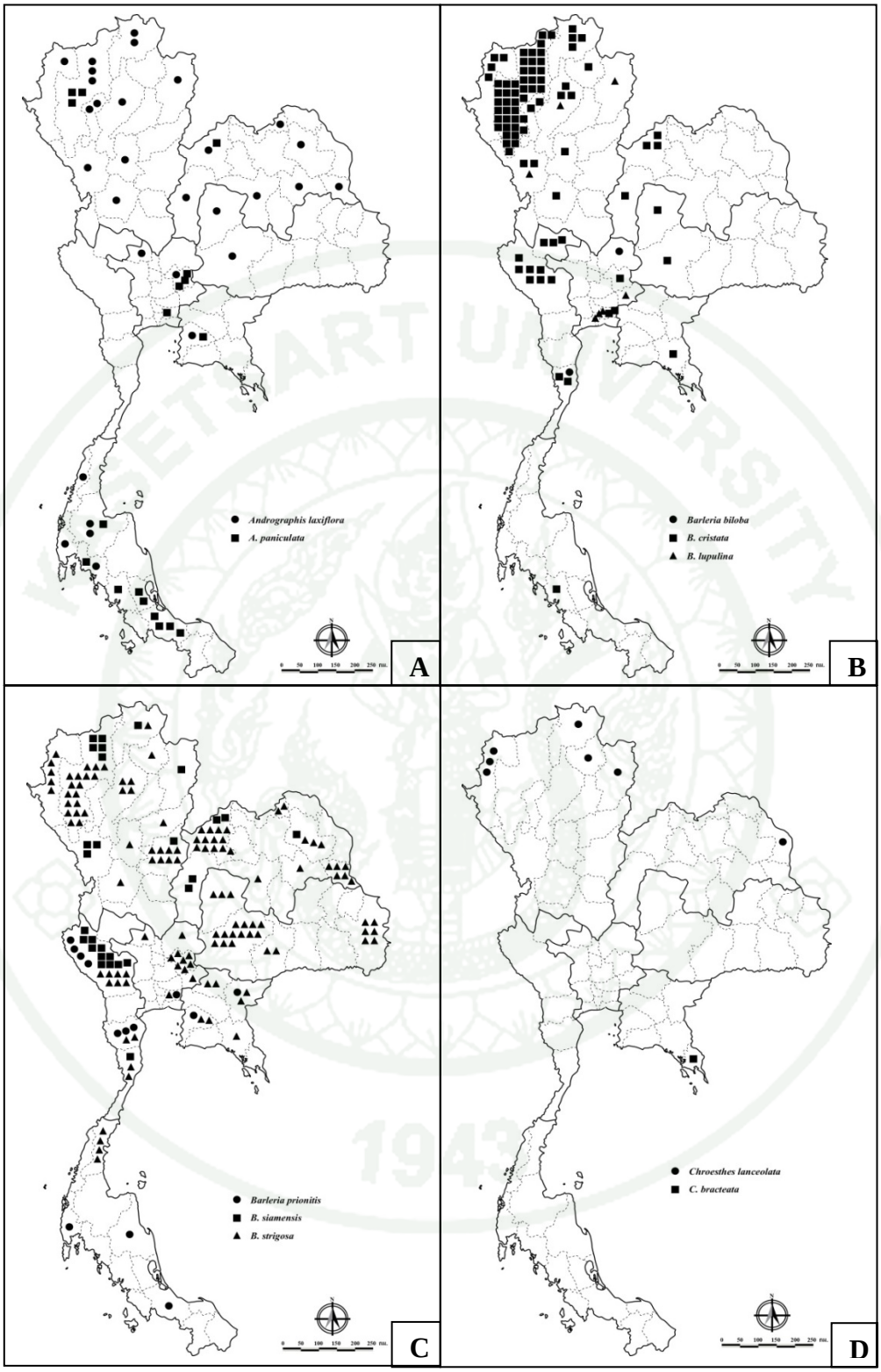

Figure 28 Distribution Maps of the Subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand

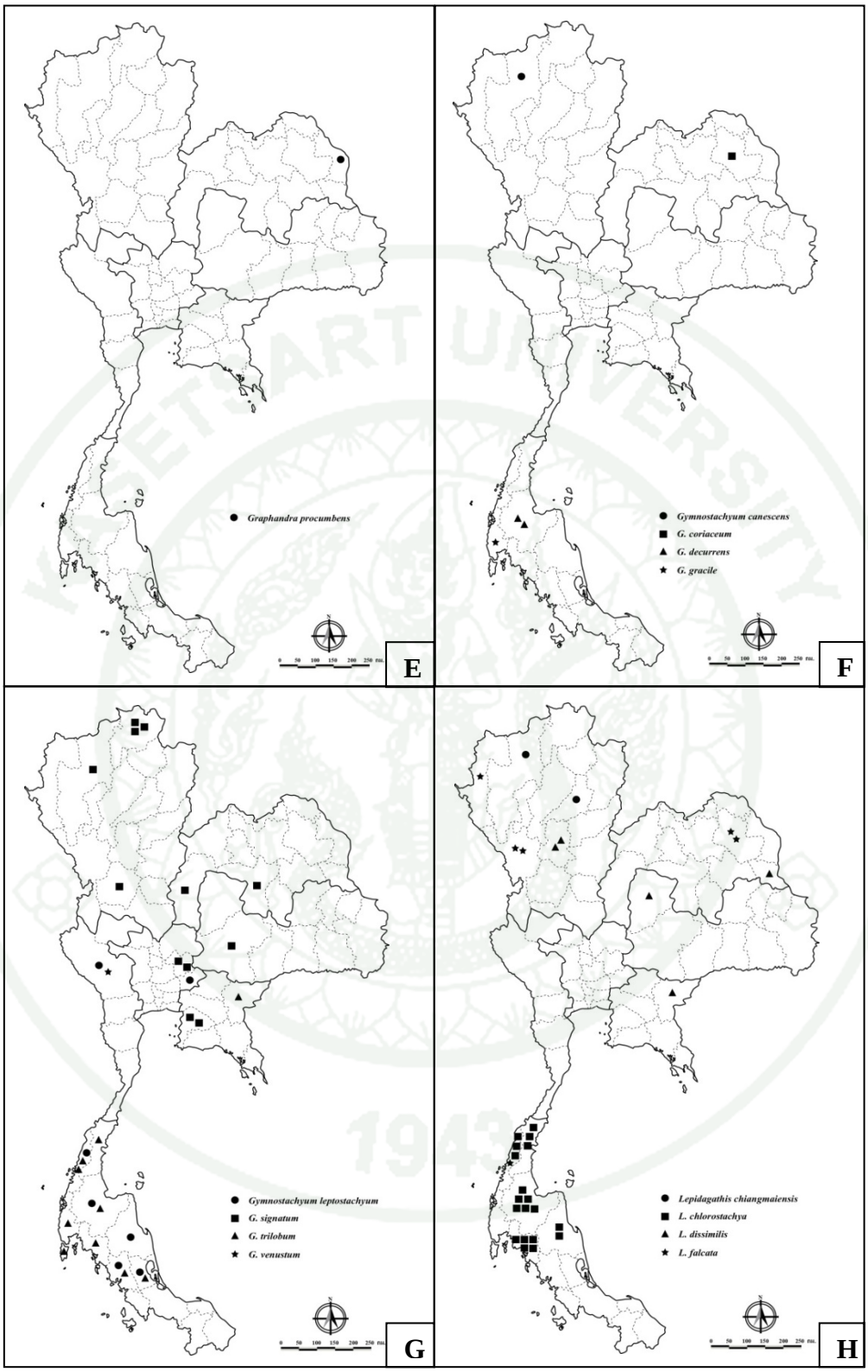

Figure 28 (Continued)

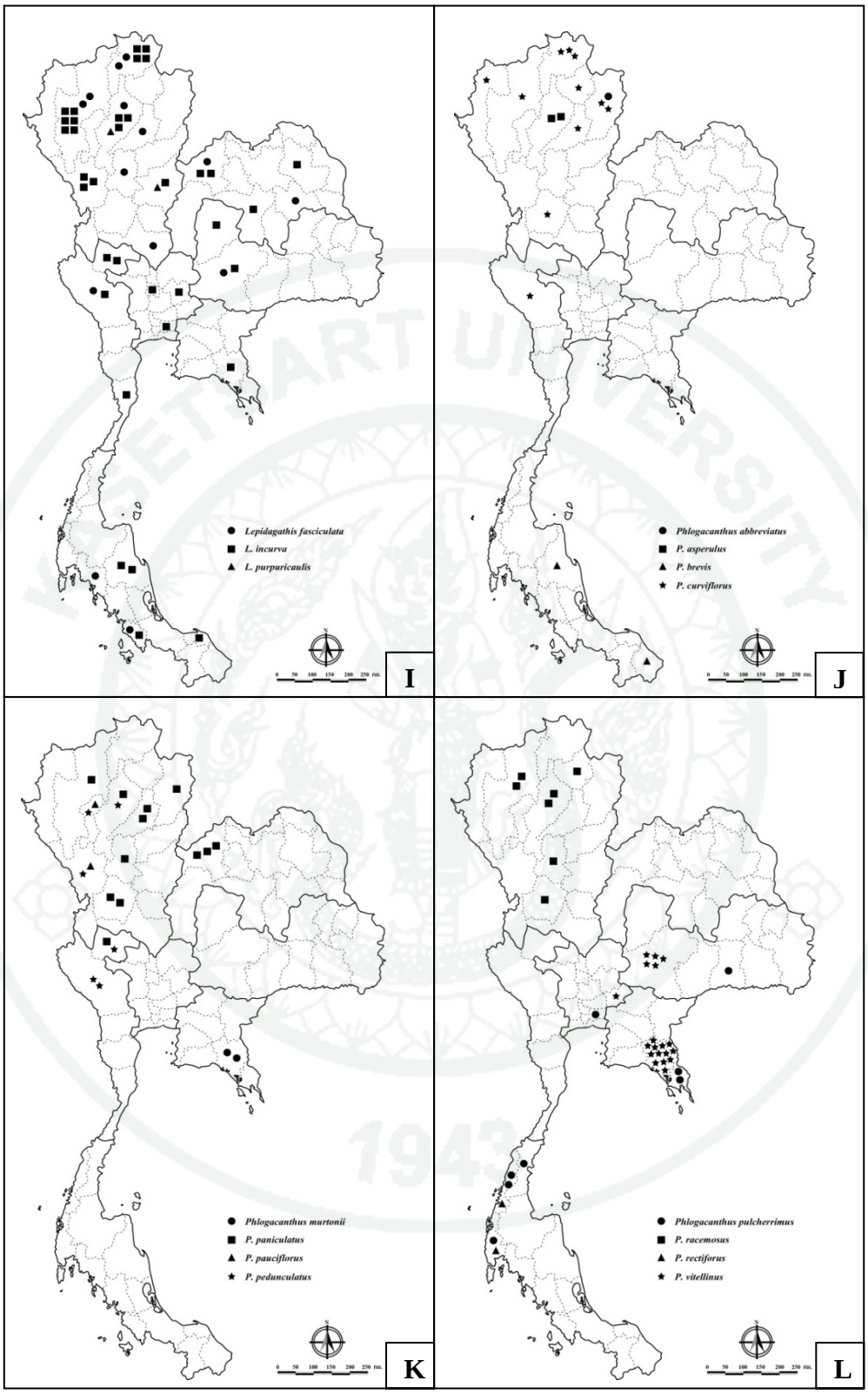

Figure 28 (Continued)

3. Seed morphology

Mature seeds of 12 representative species of the subtribe Barleriinae (2 genera), *Barleria*: (*Barleria cristata*, *B. lupulina*, *B. strigosa*) and *Lepidagathis*: *Lepidagathis dissimilis*, *L. falcata, L. fasciculata*, *L. incurva*) and the subtribe Andrographiane (3 genera), (*Andrographis*: *Andrographis laxiflora*; *Gymnostachyum*: *Gymnostachyum leptostachyum*; *Phlogacanthus*: *Phlogacanthus curviflorus*, *P. pedunculatus*, *P. pulcherrimus*) in Thailand were collected in the field. Voucher specimens from the fieldwork were deposited in BK (Table 4).

Morphological features of representarive seeds of the Subtribe Barleriinae and Andrographinae, Family Acanthaceae have been described as ovoid and strongly compressed or compressed. The features of testa were recognized as tubercle, tuberculate, rugulose, coarsely or finely scaled. The result showed that the seed varies from slightly to markedly compressed.

The result showed that the testa were found in various species, *viz* rugulose-tubercle (*Andrographis laxiflora*), rugulose (*Gymnostachyum leptostachyum*), finely tuberculate (*Phlogacanthus pedunculatus*), finely scaled (*Barleria cristata*, *B. lupulina*), coarsely scaled (*B. strigosa*, *Lepidagathis dissimilis*, *L. falcata, L. fasciculata*, *Phlogacanthus pulcherrimus*); sub-orbicular (*Lepidagathis falcata*, *L. incurva*) (Figure 29; 30 and 31) (Table 4)

The features of seed shape vary in different species, *viz* ovoid group (*Andrographis laxiflora*, *Barleria cristata*, *B. strigosa*, *Gymnostachyum leptostachyum*, *Lepidagathis dissimilis*, *L. fasciculate*, *Phlogacanthus pedunculatus*, *P. pulcherrimus*); ellipsoid (*Barleria lupulina*, *Phlogacanthus curviflorus*) (Figure 29; 30 and 31) (Table 4).

The current study is an evidence to support the taxonomic significance of seed morphology of both subtribes in Thailand. Cross (2013) reported that the seed shape and size of Acanthaceae may vary slightly in fruit morphology, pollen morphology are the main features for identifying among the family but in this study was not corresponded to the latter. The result showed seed morphology did not support the taxonomy of these two subtribes clearly.

Table 4 List of specimens examined for seed morphology of some species in Subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand

	Taxa	Voucher Specimen	Locality
1.	*Andrographis laxiflora*	Winai Somprasong 014090208-5 (BK)	Phusang District, Phayao Province
2.	*Barleria cristata*	Winai Somprasong 012011207-4 (BK)	Tambon Kongkhaek, Mae Chaem District, Ching Mai Province
3.	*B. lupulina*	Winai Somprasong 052080112-1 (BK)	Mae Ramat District, Tak Province
4.	*B. strigosa*	Winai Somprasong 014040108-11 (BK)	Bo Klua District, Nan Province
5.	*Gymnostachyum leptostachyum*	Sakol Sutheesorn 2831 (BK)	Khirirat Nikhom District, Surat Thani Province
6.	*Lepidagathis dissimilis*	J.F. Maxwell 74-68 (BK)	Muang Kao, Sukhothai Province
7.	*L. falcata*	Winai Somprasong 016090112-3 (BK)	Mae La Noi District, Mae Hong Son Province
8.	*L. fasciculata*	Sakol Sutheesorn 3581 (BK)	Phu Phan, Somdet District, Kalasin Province
9.	*L. incurva*	A. Marcan 1531 (BK)	Pakchong District, Nakhon Ratchasima Province
10.	*Phlogacanthus curviflorus*	Winai Somprasong 052080112-10 (BK)	Tha Song Yang District, Tak Province
11.	*P. pedunculatus*	Winai Somprasong 055250212-1 (BK)	Ban Bung, Ban Kha District, Ratcha Buri Province
12.	*P. pulcherrimus*	Winai Somprasong 012121213-5 (BK)	Mae Tang District, Chiang Mai Province

Table 5 Seed morphology and measurements of the Subtribe Barleriinae and Andrographinae (Acanthaceae) in Thailand

Taxa	Shape	Color	Testa	Size	
				width(mm)	length(mm)
Andrographis laxiflora	ovoid	reddish brown	rugulose-tubercle	1241.56±31.22	2201.37±230.85
Barleria cristata	ovoid	pale brown	finely scaled	2081.20±131.87	2517.70±134.41
B. lupulina	ellipsoidal	yellowish brown	finely scaled	3395.75±69.99	6242.65±162.72
B. strigosa	ovoid	yellowish brown	coarsely scaled	3180.61±365.22	3416.67±215.09
Gymnostachyum leptostachyum	ovoid	pale brown	rugulose-tuberculate	585.97±64.47	932.41±108.97
Lepidagathis dissimilis	ovoid	yellowish brown	coarsely scaled	4807.95±580.38	5013.31±411.78
L. falcata	suborbicular	yellowish brown	coarsely scaled	3395.75±69.99	6242.65±162.72
L. fasciculata	ovoid	yellowish brown	coarsely scaled	2880.72±146.21	3480.71±301.16
Lepidagathis incurva	suborbicular	pale brown	finely scaled, adpressed	1280.89±228.04	1361.23±157.47
Phlogacanthus curviflorus	ellipsoidal	yellowish brown	finely tubercle	2616.78±275.08	3210.31±359.80
P. pedunculatus	ovoid	pale brown	coarsely scaled	2819.46±164.40	2800.09±72.60
P. pulcherrimus	ovoid	reddish brown	coarsely scaled	2619.06±501.32	3074.10±251.93

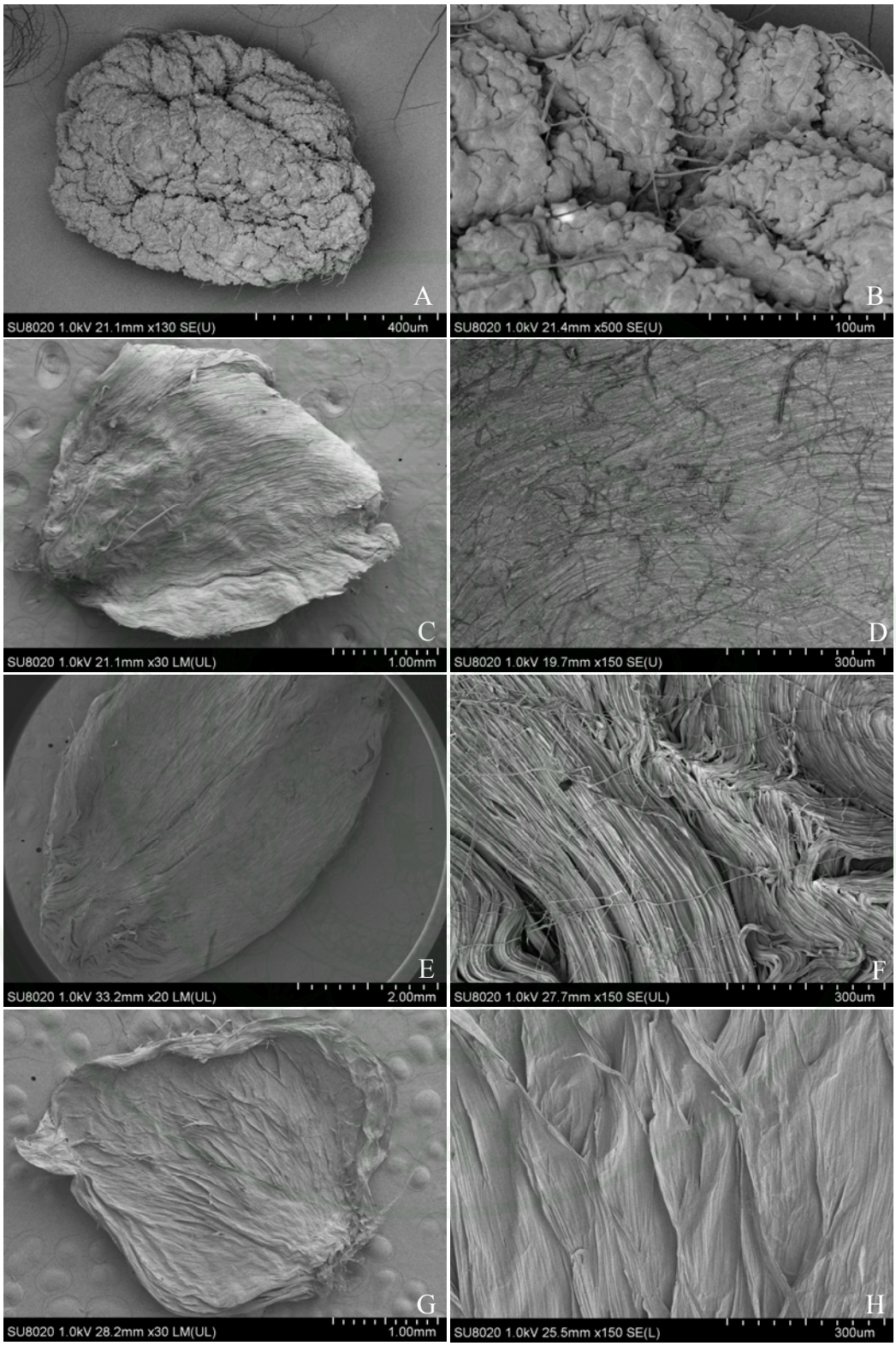

Figure 29 SEM micrographs of seeds in the Subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand
A-B: *Andrographis laxiflora*, C-D: *Barleria cristata*, E-F: *B. lupulina*, G-H: *B. strigosa*

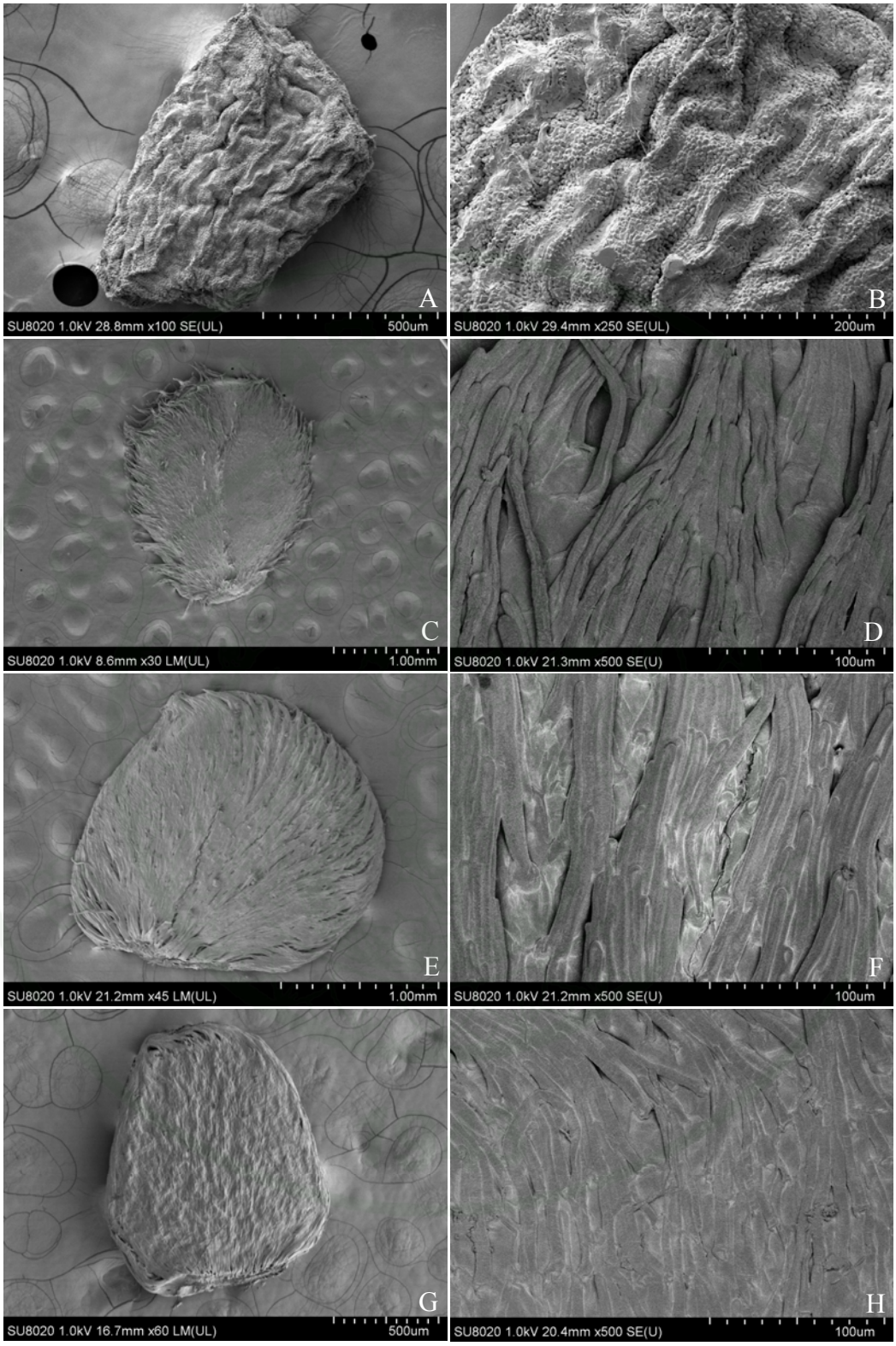

Figure 30 SEM micrographs of seeds in the Subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand
A-B: *Gymnostachyum leptostachyum*, C-D: *Lepidagathis dissimilis*, E-F: *L. falcata*, G-H: *L. fasciculata*

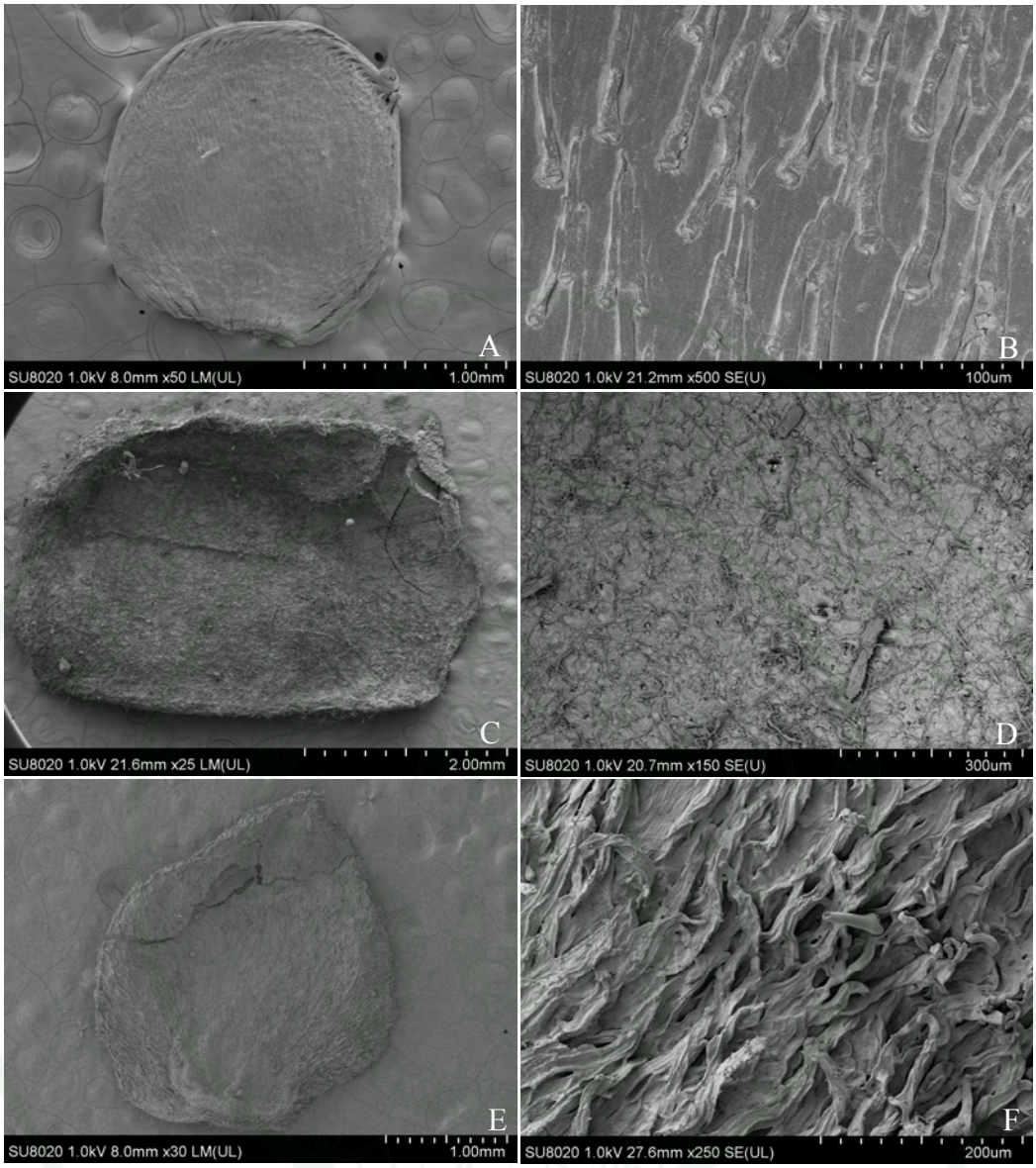

Figure 31 SEM micrographs of seeds in the Subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand
A-B: *Lepidagathis incurva*, C-D: *Phlogacanthus curviflorus*, E-F: *P. pulcherrimus*

4. Palynological study

Present pollen study is based on 16 species of Acanthaceae, distributed in 6 genera, *viz Andrographis laxiflora*, *A. paniculata*, *Barleria cristata*, *B. lupulina*, *B. prionitis*, *B. siamensis*, *B. strigosa*, *Chroesthes lanceolata*, *Gymnostachyum signatum*, *G. trilobum*, *G. venustum*, *Lepidagathis falcata*, *Phlogacanthus paniculatus*, *P. pauciflorus*, *P. pulcherrimus*, *P. rectiflorus* (Table 6).

On the basis of shape class and ornamentation in the subtribes Barleriinae and Andrographinae, Family Acanthaceae had been divided into eight distinct pollen types, *viz*

Pollen shape type-I (prolate spheroidal): *Andrographis laxiflora*, *Lepidagathis falcata*, *Phlogacanthus pauciflorus*.

Pollen shape type-II (oblate spheroidal): *Aandrographis paniculata*, *Phlogacanthus rectiflorus*.

Pollen shape type-III (oblate): *Chroesthes lanceolata*, *Gymnostachyum signatum*, *G. trilobum*, *G. venustum*.

Pollen shape type-IV (subspheroidal): *Barleria cristata*, *B. lupulina*, *B. prionitis*, *B. siamensis*, *B. strigosa*.

Pollen shape type-V (suboblate): *Phlogacanthus paniculatus*, *P. pulcherrimus*.

Pollen ornamentation type-I (reticulate tectum): *Andrographis laxiflora*.

Pollen ornamentation type-II (open reticulate tectum): *Andrographis paniculata*, *Barleria cristata*, *B. lupulina*, *B. prionitis*, *B. siamensis*, *B. strigosa*.

Pollen ornamentation type-III (reticulate with granulate in lumina): *Gymnostachyum signatum.*

Pollen ornamentation type-IV (finely Reticulate tectum with granulate in lumina): *Gymnostachyum trilobum*.

Pollen ornamentation type-V (reticulate tectum with distinct aperture margin): *Gymnostachyum venustum*.

Pollen ornamentation type-VI (open reticulate tectum, granulate in lumina): *Lepidagathis falcata*.

Pollen ornamentation type-VII (finely Reticulate tectum with distinct aperture margin): *Phlogacanthus paniculatus*, *P. pauciflorus*, *P. pulcherrimus*, *P. rectiflorus*.

Table 6 List of specimen examined for pollen morphological study

Taxa	Voucher Specimen	Locality
Andrographis laxiflora	Winai Somprasong 014090208-5 (BK)	Phusang District, Phayao Province
A. paniculata	Winai Somprasong 052160213-4 (BK)	Mae Ramat District, Tak Province
Barleria cristata	Winai Somprasong 012011207-4 (BK)	Tambon Kongkhaek, Mae Chaem District, Ching Mai Province
B. lupulina	Winai Somprasong 052080112-1 (BK)	Mae Ramat District, Tak Province
B. prionitis	Winai Somprasong 013040108-2 (BK)	Tambon Silalaeng, Pua District, Nan Province
B. siamensis	Winai Somprasong 05426110-2 (BK)	Kaeng Krachan District, Phet Buri Province
B. strigosa	Winai Somprasong 014040108-11 (BK)	Bo Klua District, Nan Province
Chroesthes lanceolata	Winai Somprasong 013070154-1 (BK)	Song Khwae District, Nan Province
Gymnostachyum signatum	Winai Somprasong 311080113-4 (BK)	Na Haew District, Loei Province
G. trilobum	Winai Somprasong 061240612-1 (BK)	Tambon Thapprik, Muang District, Krabi Province
G. venustum	Winai Somprasong 051280908-5 (BK)	Kaeng Krachan District, Phet Buri Province
Lepidagathis falcata	Winai Somprasong 016090112-3 (BK)	Mae La Noi District, Mae Hong Son Province
Phlogacanthus paniculatus	Winai Somprasong 013030108-2 (BK)	Tambon Saentong, Tha Wang Pha District, Nan Province
P. pauciflorus	Winai Somprasong 014090208-7 (BK)	Tambon Thungkluai, Phu Sang District, Phayao Province
P. pulcherrimus	Winai Somprasong 012121213-5 (BK)	Mae Tang District, Chiang Mai Province
P. rectiflorus	Winai Somprasong 062280308-2	Tambon Wangtako, Langsuan District, Chumphon Province

There is a remarkable diversity in terms of the pollen morphology in the Family Acanthaceae for various characters such as pollen size, shape, aperture and tectum. This variation has already been observed by the previous workers, such as, Radlkofer (1883) and Lindau (1893,1895), He recognized 11 pollen types, which were used in subfamilial classification. Similarly, Rizzini (1947) examined pollen morphology of many Brazilian genera and utilized pollen characters for delimiting the genera. So present pollen morphological charaters seem to be useful at the tribal, subtribal and generic level. All the subtribes Barleriinae and Andrographinae genera consists of the species that are relatively homogenous as far as the pollen characters are concerned. Some representative species not covered all of the collection were undertaken by lax of flowers in some species so the result of this study did not correspond to Rizzini (1947).

Table 7 Pollen morphology and measurements of the subtribe Barleriinae and Andrographinae, Family Acanthaceae in Thailand

Taxa	Shape	Size (µm)		P/E	Type of aperture	Ornamentation
		Equatorial axis (E)	Polar axis (P)			
Andrographis laxiflora	prolate	40.09±1.81	45.56±2.62	1.14	Tricolporate ora circular	Reticulate tectum
A. paniculata	spheroidal oblate	61.58±3.48	56.84±4.21	0.93		
Barleria cristata	spheroidal subspheroidal	107.41±6.75	106.67±5.50	0.99	Tricolporate ora circular	Open reticulate tectum
B.lupulina	subspheroidal	114.50±2.82	109.04±5.83	0.95	Tricolporate ora circular	Open reticulate tectum
B. prionitis	subspheroidal	103.47±2.18	97.98±3.91	0.95	Tricolporate ora circular	Open reticulate tectum
B. siamensis	subspheroidal	106.53±12.90	115.32±3.55	1.08	Tricolporate ora circular	Open reticulate tectum
B. strigosa	subspheroidal	141.52±4.34	137.87±10.52	0.97	Tricolporate ora circular	Open reticulate tectum
Chroesthes lanceolata	oblate	57.79±1.88	41.67±1.55	0.72	Tricolporate ora circular	reticulate
Gymnostachyum signatum	oblate	54.58±3.15	32.30±1.24	0.59	Tricolporate ora circular	Reticulate with granulate in lumina

Table 7 (Continued)

Taxa	Shape	Size (μm)		P/E	Type of aperture	Ornamentation
		Equatorial axis (E)	Polar axis (P)			
Gymnostachyum trilobum	oblate	51.63±6.01	32.36±2.88	0.63	Tricolporate ora circular	Finely Reticulate tectum with granulate in lumina
G. venustum	oblate	42.70±4.22	29.29±1.40	0.69	Tricolporate ora circular	Reticulate tectum with distinct aperture margin
Lepidagathis falcata	prolate	64.64±2.68	66.91±5.26	1.04	Tricolporate ora circular	Open reticulate tectum, granulate in lumina
Phlogacanthus paniculatus	spheroidal suboblate	44.35±1.76	33.92±1.89	0.76	Tricolporate ora circular	Finely Reticulate tectum with distinct aperture margin
P. pauciflorus	prolate spheroidal	40.50±8.38	40.30±2.21	1.00	Tricolporate ora circular	Finely Reticulate tectum with distinct aperture margin
P. pulcherrimus	suboblate	41.61±2.17	32.53±3.79	0.78	Tricolporate ora circular	Finely Reticulate tectum with distinct aperture margin
P. rectiflorus	oblate spheroidal	43.15±5.82	38.85±2.79	0.90	Tricolporate ora circular	Finely Reticulate tectum with distinct aperture margin

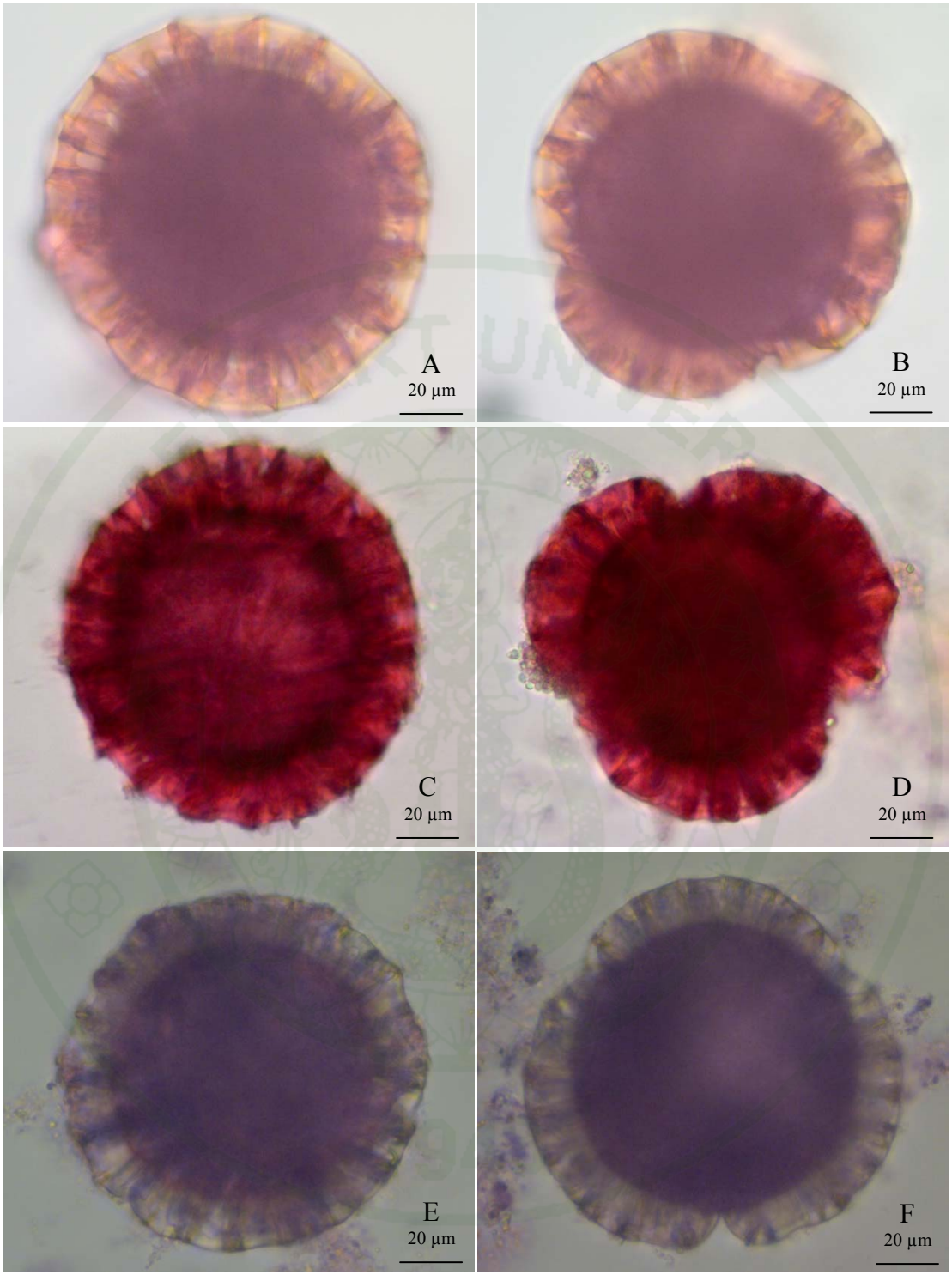

Figure 32 LM micrographs of pollen: A-B. *Barleria lupulina*; C-D. *B. prionitis*; E-F. *B. siamensis*

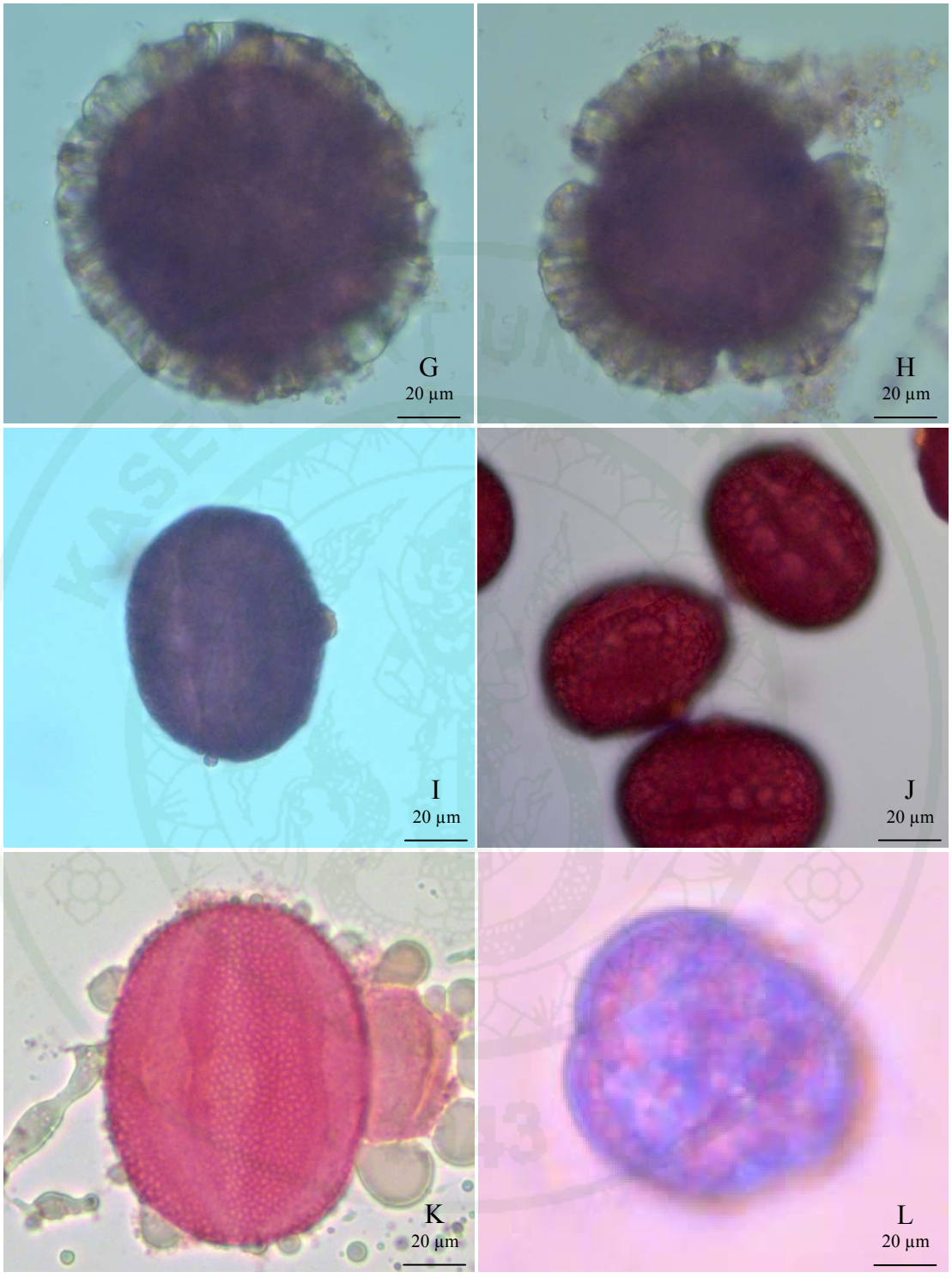

Figure 33 LM micrographs of pollen: A-B. *Barleria strigosa*; C-D. *Chroesthes bracteata*; E-F. *Gymnostachyum trilobum*

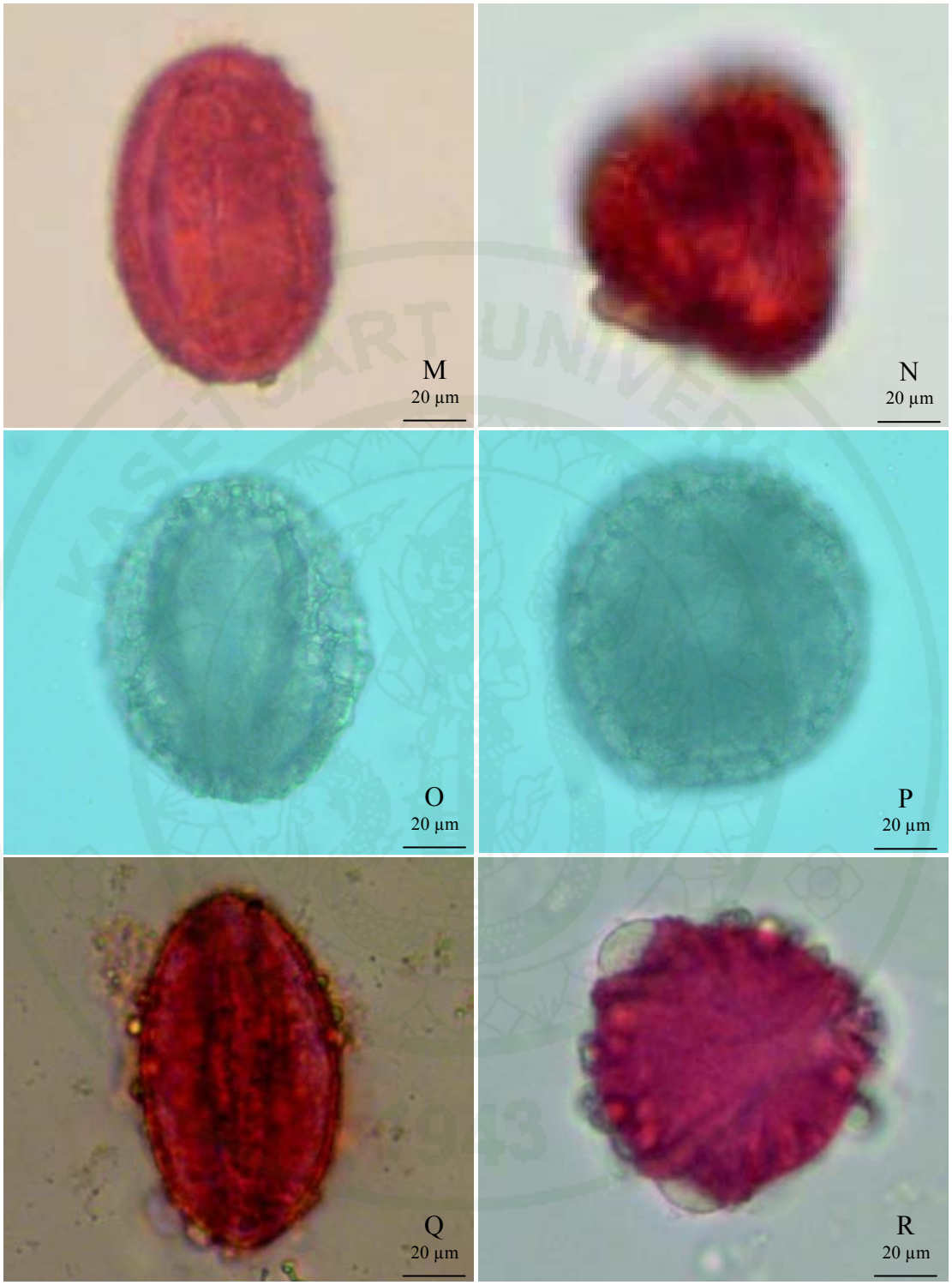

Figure 34 LM micrographs of pollen: A-B. *Lepidagathus chlorostachya*; C-D. *Lepidagathus falcata*; E-F. *Phlogacanthus pauciflorus*

Figure 35 LM micrographs of pollen: A-B. *Phlogacanthus vitellinus*

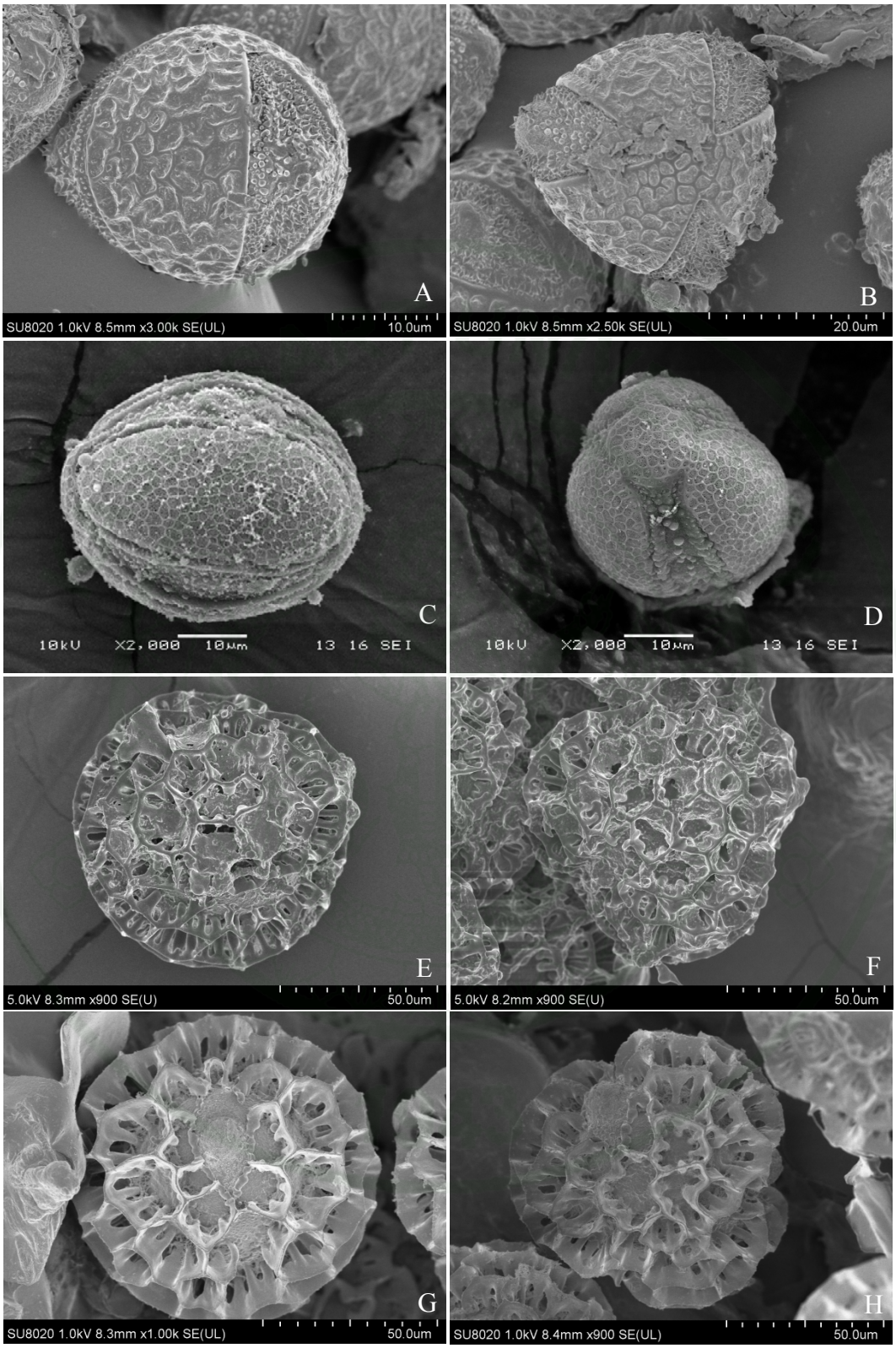

Figure 36 SEM micrographs of pollen grains : A-B. *Andrographis laxiflora*; C-D. *A. paniculata*; E-F. *Barleria cristata*; G-H. *B. lupulina*

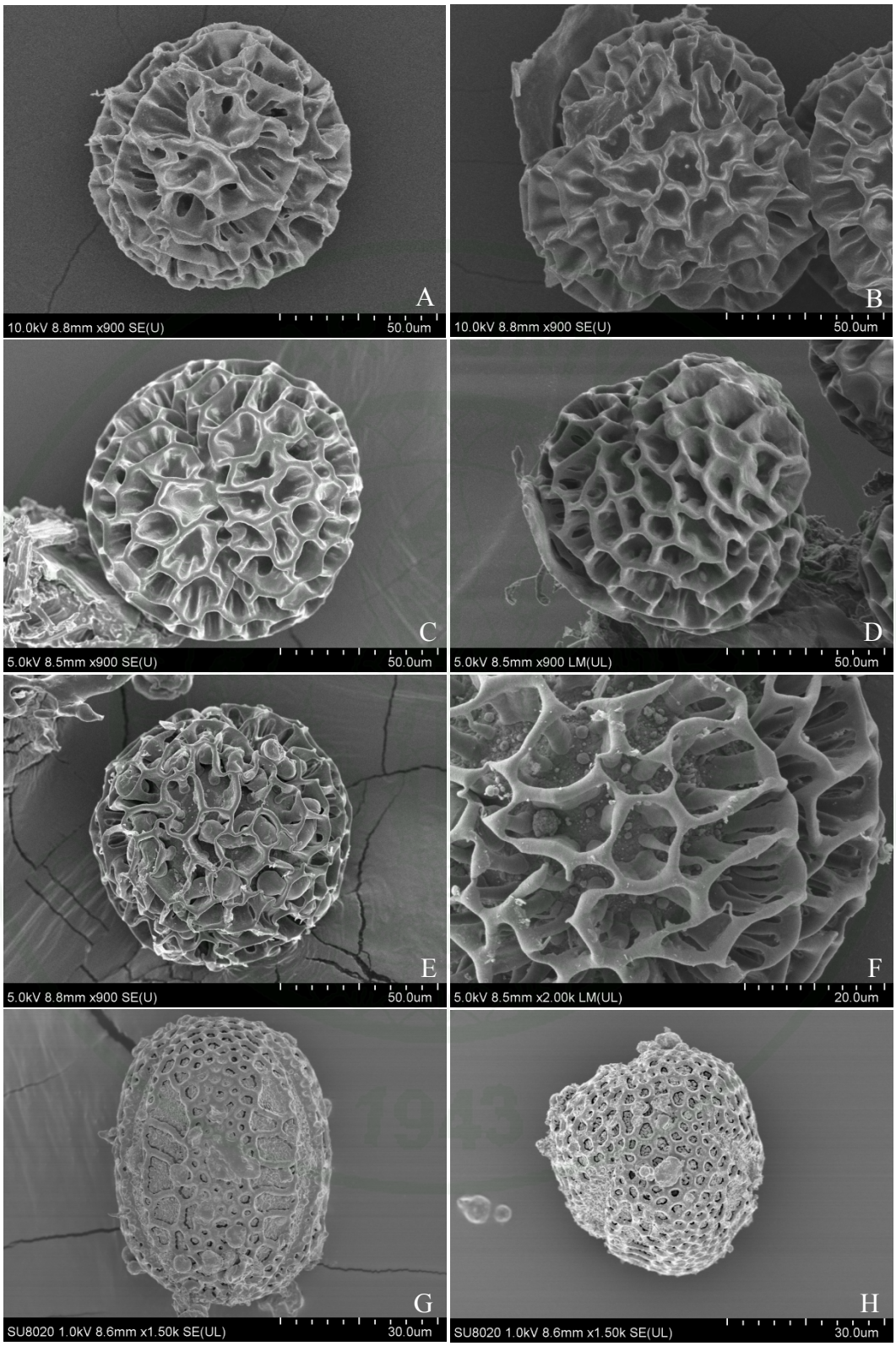

Figure 37 SEM micrographs of pollen grains : A-B. *Barleria prionitis*; C-D. *B. siamensis*; E-F. *B. strigosa*; G-H. *Chroesthes lanceolata*

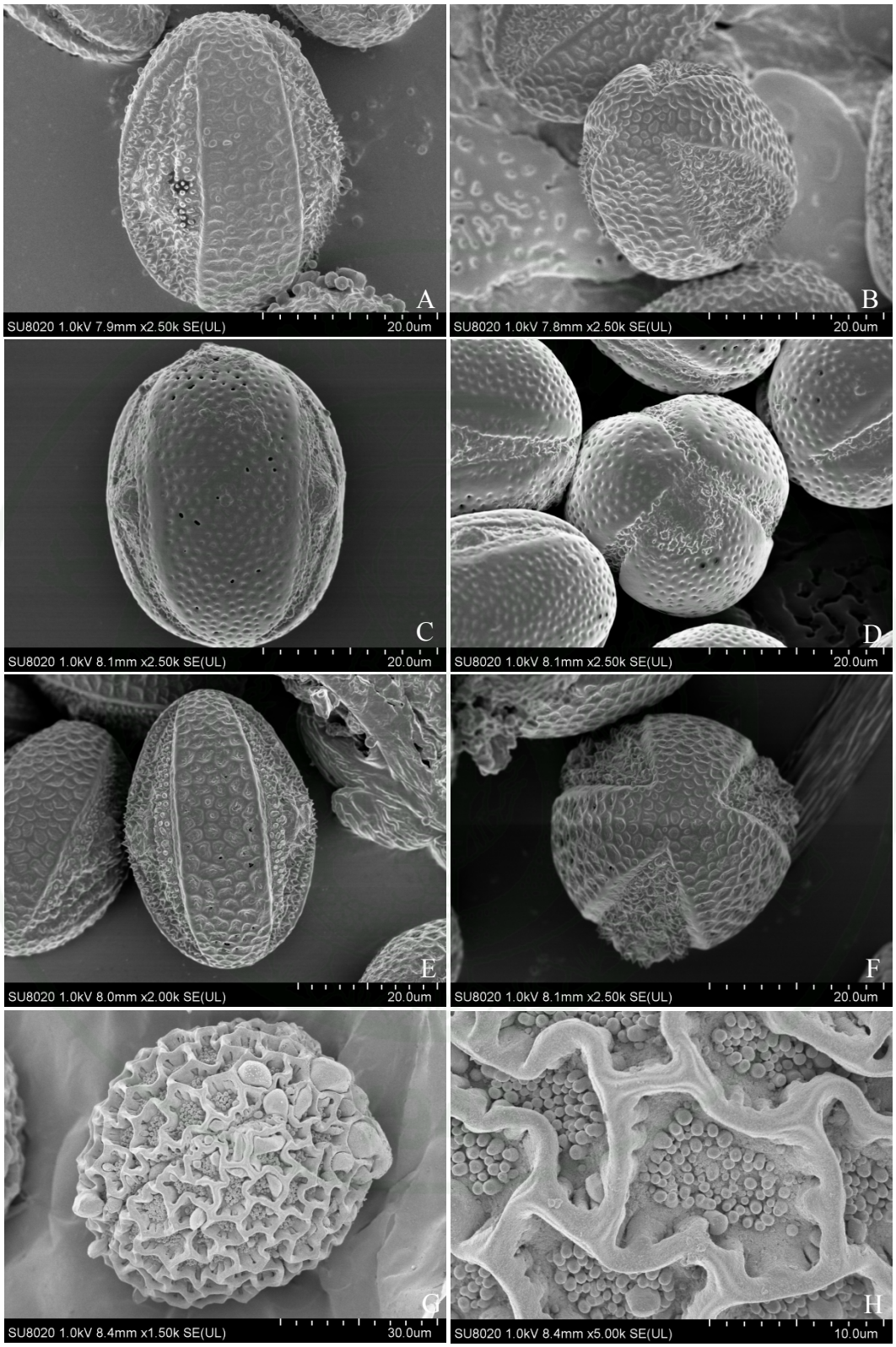

Figure 38 SEM micrographs of pollen grains : A-B. *Gymnostachyum signatum*; C-D. *G. trilobum*; E-F. *G. venustum*; G-H. *Lepidagathis falcata*

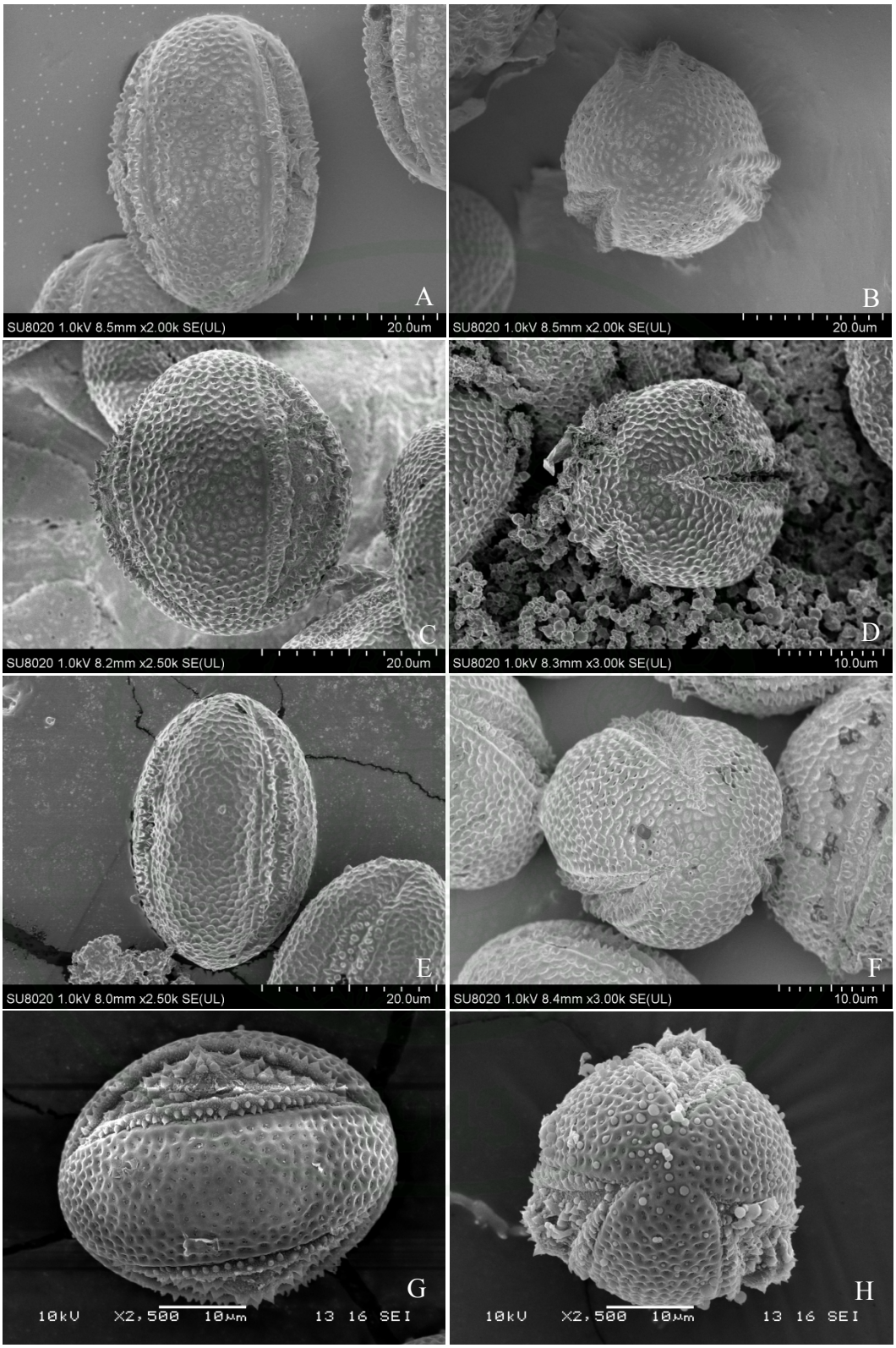

Figure 39 SEM micrographs of pollen grains : A-B. *Phlogacanthus curviflorus*; C-D. *P. pauciflorus*; E-F. *P. pedunculatus*; G-H. *P. pulcherrimus*

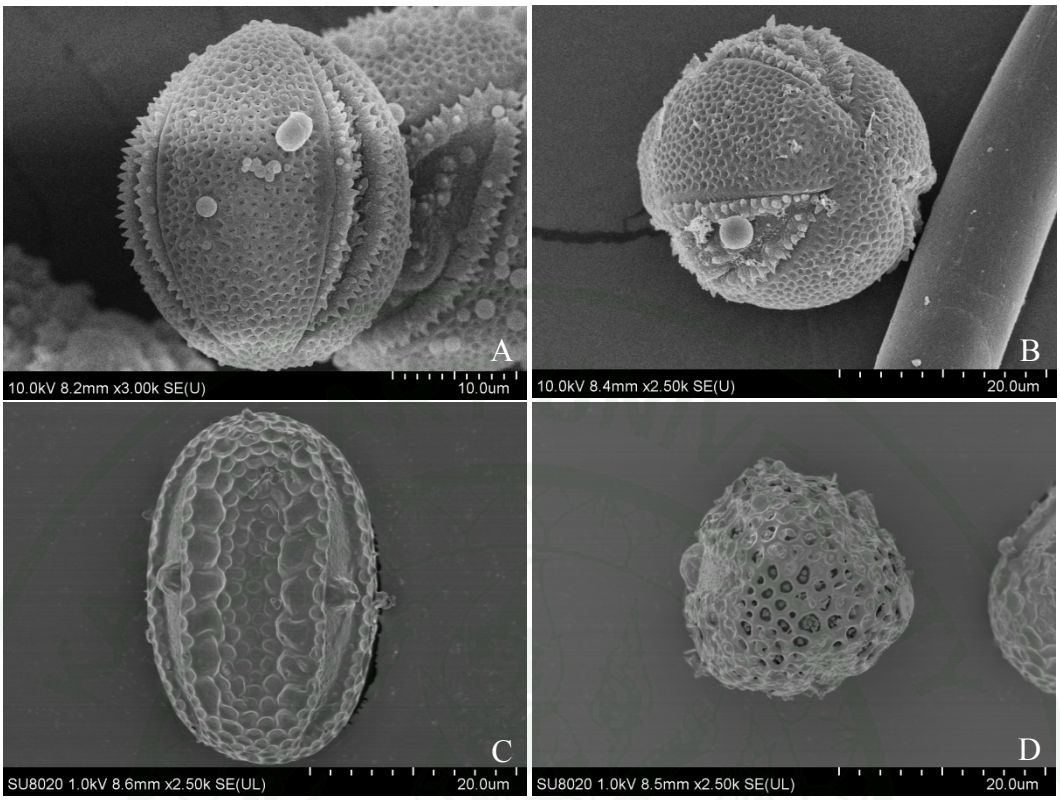

Figure 40 SEM micrographs of pollen grains : A-B. *Phlogacanthus rectiflorus*; C-D. *P. vittellinus*

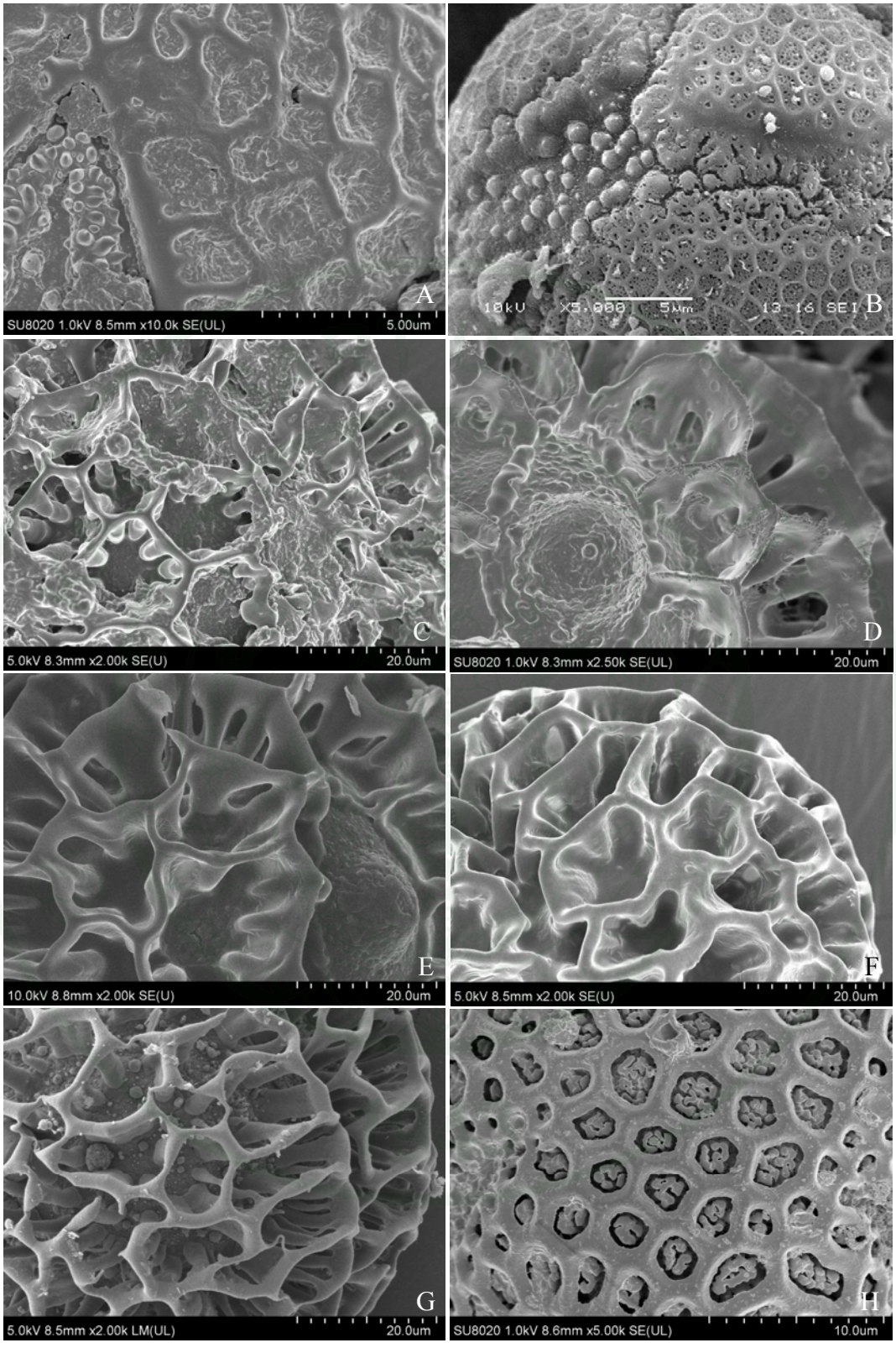

Figure 41 SEM Micrographs of ektexine surface: A. *Andrographis laxiflora*; B. *A. paniculata*; C. *Barleria cristata*; D. *B. lupulina*; E. *B. prionitis*; F. *B. siamensis*; G. *Barleria strigosa*; H. *Chroesthes lanceolata*

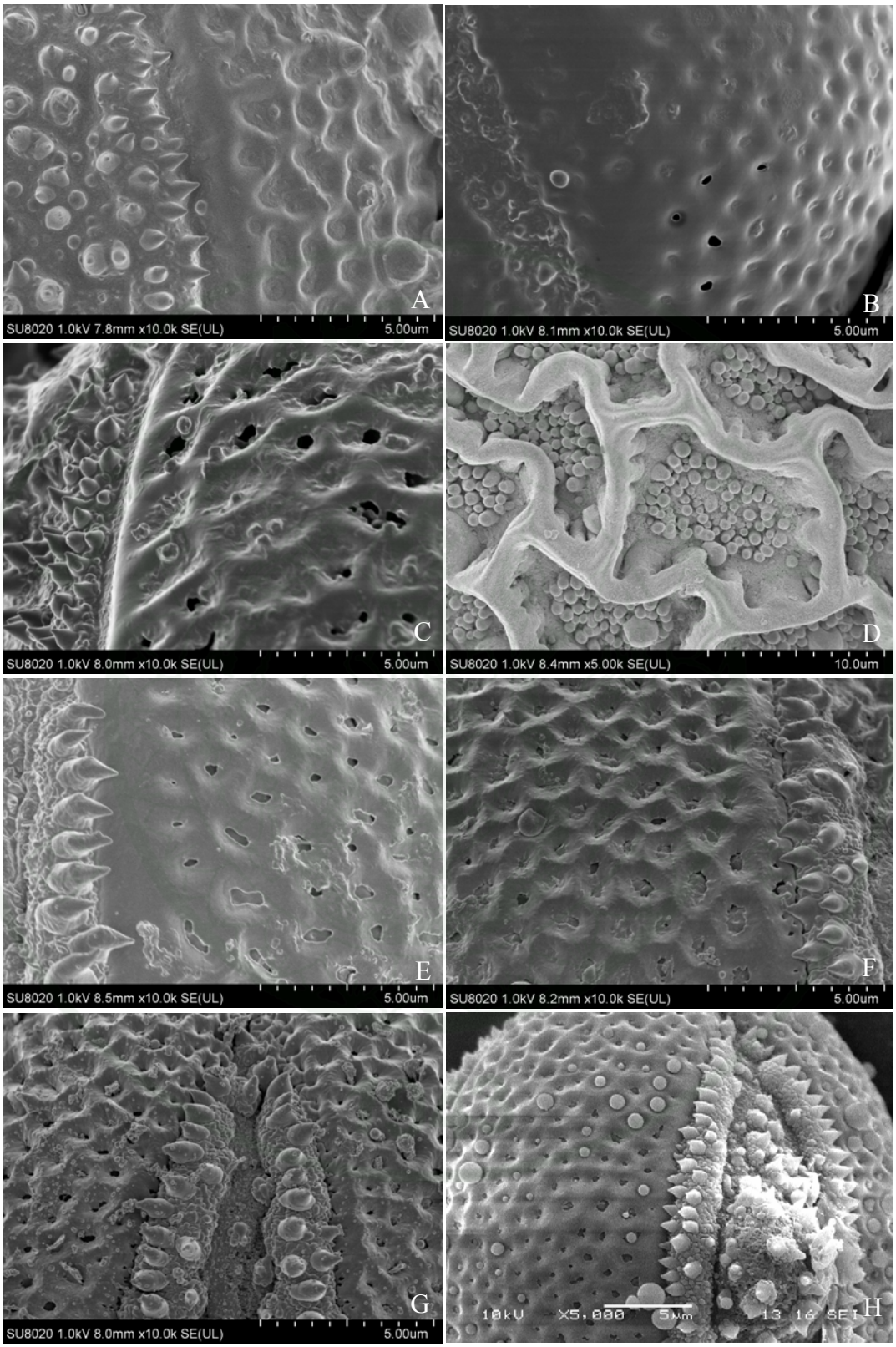

Figure 42 SEM Micrographs of ektexine surface: A. *Gymnostachyum signatum*; B. *G. trilobum*; C. *G. venustum*; D. *Lepidagathis falcata*; E. *Phlogacanthus curviflorus*; F. *P. pauciflorus*; G. *P. pedunculatus*; H. *P. pulcherrimus*

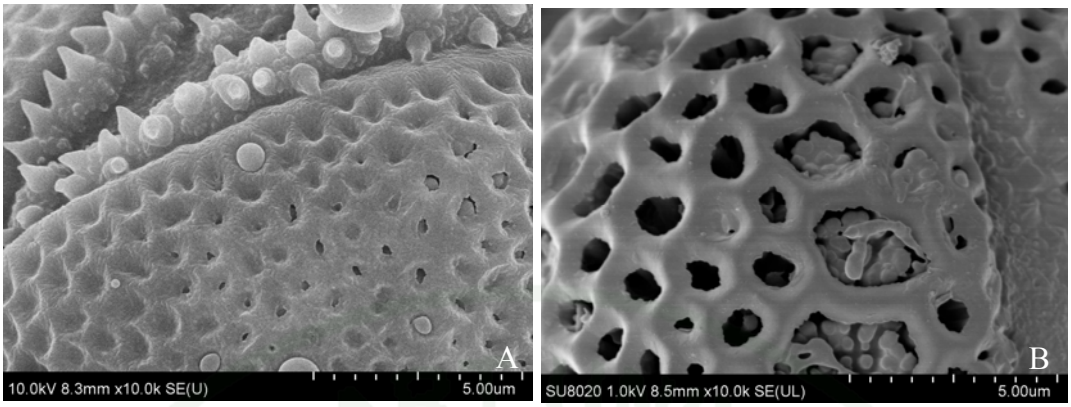

Figure 43 SEM Micrographs of ektexine surface:, SEM: A. *Phlogacanthus rectiflorus*; B. *P. vittellinus*

5. Chromatographical study

The EtOAc extracts of stems, roots and leaves were investigated using TLC (Table 8). The compiled chromatogram profiles of *Barleria* extracts are shown (Figure 44), Rf values with their distribution with respect to spot numbers are shown. Classification of the similarity in pattern of distribution of the spots in all species have been evaluated without chemical identification. The total number of spot positions of this studied species was 15 samples, some spots had common occurrence among the species and some were exclusive for certain species. Most pattern spot profiles of stem and leaf of each species were related.

Table 8 List of specimen examined for TLC study.

No.	Taxa	Habit	Voucher specimen
BB1 LB 1 RB1	*Barleria cristata*	Erect form	Winai Somprasong 012151011-2 (BK) Tambon Mae Khuek, Mae Chaem District, Chiang Mai Province
BB2 LB 2 RB2	*Barleria cristata*	Decumbent form	Winai Somprasong 012151011-1 (BK) Tambon Mae Khuek, Mae Chaem District, Chiang Mai Province
BB3 LB3 RB3	*Barleria cristata*	Erect form with flowers fascicled	Winai Somprasong 012151011-3 (BK) Tambon Mae Khuek, Mae Chaem District, Chiang Mai Province
BB4 LB4 RB4	*Barleria strigosa*	Undershrub, leaves glabrous	Winai Somprasong 014040108-11 (BK) Mae Salit Luang, Tha Song Yang, Tak
BB5 LB5 RB5	*Barleria strigosa*	Herb, leave arrangemen radical, dense - hair	Winai Somprasong 014040108-10 (BK) Mae Salit Luang, Tha Song Yang, Tak

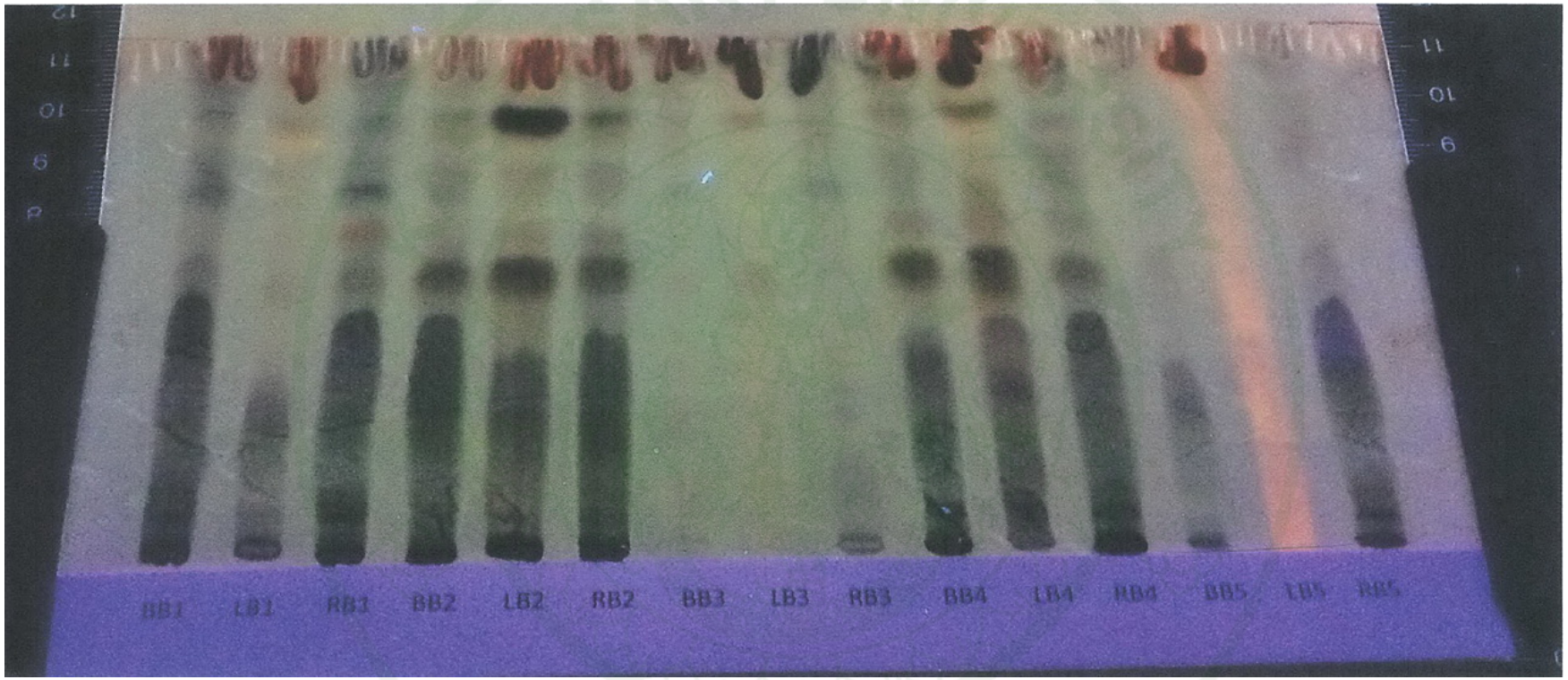

Figure 44 TLC fingerprint profile of *Barleria* extracts under 366 nm after spraying anisaldehyde sulphuric acid reagent

Remarks: BB1, LB1, RB1 = *Barleria cristata* (erect form)
BB2, LB2, RB2 = *Barleria cristata* (decumbent form)
BB3, LB3, RB3 = *Barleria cristata* (erect form with flowers fascicled)
BB4, LB4, RB4 = *Barleria strigosa* (undershrub, leaves glabrous)
BB5, LB5, RB5 = *Barleria strigosa* (herb, leaf arrangement radical, dense - hair)

The chromatographical study showed the differences among three habit of *Barlertia cristata*. *B. cristata* (erect form) (Appendix Figure 1G and 1H) and *B. cristata* (decumbent form) (Appendix Figure 1E and 1F) are similar, but they differ from *B. cristata* (erect form with flowers fascicled) (Appendix Figure 1C and 1D). It was shown that *B. strigosa* (undershrub, leaves glabrous) (Appendix Figure 2E and 2F) is not so much different and *B. strigosa* (herb, leaf arrangement radical, dense - hair) (Appendix Figure GE and 2H). Since TLC technique had been done by using unfixed concentration, so the result from chromatographic profile showed undistinctive clarification.

CONCLUSION

The floral morphology of Acanthaceae in two subtribes differ from each other. The features of corolla aestivation are highly recognized among various genera of Acanthaceae.

Four genera of the subtribe Andrographinae (*Andrographis*, *Graphandra*, *Gymnostachyum* and *Phlogacanthus*) have distinct floral characters (calyx, corolla and stamen)**.** The floral characters of Andrographinae showed distinct features among the subtribe as follows.

1. Calyx deeply 5 - lobed, small, segments equal or subequal were found in 3 genera but *Graphandra* was found as calyx deeply 4 – lobed.

2. Corolla subequally 5 – lobed was found in *Andrographis* and the other were found as corolla bilabiate (*Graphandra* and *Gymnostachyum*), but corolla tube ventricose found in most of *Phlogacanthus.*

3. Bract and bracteole was found similar among four genera but some species were found absent in *Andrographis* and *Phlogacanthus*.

4. Stamen 2 were found among four genera, They are free except *Graphandra* adnate to corolla tube.

5. Ovules 6-12 were found in *Andrographis*, 12 in *Graphandra*, 6 – many in *Gymnostachyum* and 10-16 in *Phlogacanthus***.**

Three genera of the subtribe Barleriinae (*Barleria*, *Chroesthes* and *Lepidagathis*) have distinct floral characters (calyx, corolla and stamen). The floral characters of Andrographinae showed that they have distinct features among the subtribe as follows.

1. Calyx 5 - lobed, large, segments equal or unequal were found in *Lepidagathis* Calyx segments 4, 2 outer large, 2 inner small were found in *Barleria*.
Calyx segment 5, sepals in opposite pairs, bearing outer, interior and lateral ones were found in *Chroesthes*.

2. Corolla sub-equally 5-lobed were found in *Barleria.* Corolla 2- lipped, upper 2-lobed, lower 3-lobed were found in *Chroesthes.* Corolla bilabiate were found in *Lepidagathis*.

3. Bracts were found among three genera some species are absent in *Barleria.* Besides, spinous bracts were found in some species of *Barleria.*

4. Stamen connate at the base were found in *Barleria* and *Lepidagathis.* Number of stamen wer found 4 and 2 in in *Barleria* and *Lepidagathis*, respectively. Stamen not connate at the base were found in *Chroesthes*.

5. Ovules 4 were found in *Barleria*, 2 *Chroesthes* and 6 to many in *Lepidagathis*.

The enumeration of the subtribe Andrographinae and Barleriinae (Acanthaceae) in Thailand showed that 38 taxa were recognized,

Subtribe Andrographinae (23 species), *viz. Andrographis laxiflora* (Blume) Lindau, *A. paniculata* (Burm.) Wall. ex Nees, *Graphandra procumbens* Imlay, *Gymnostachyum canescens* (Nees) T. Anders., *G. coriaceum* Imlay, *G. decurrens* Stapf, *G. gracile* Bremek., *G. leptostachyum* Nees, *G. signatum* (Benoist) Imlay, *G. trilobum* Ridl., *G. venustum* (Wall.) T. Anders., *Pholgacanthus abbriviatus* (Craib) R. Ben., *P.asperulus* Nees, *P. brevis* C.B.Clarke, *P. curviflorus* (Wall.) Nees, *P. murtonii* Craib, *P. paniculatus* (T. Anders.) J.B. Imlay, *P. pauciflorus* J.B. Imlay, *P.pedunculatus* J.B. Imlay, *P. pulcherrimus* T. Anders., *P. racemosus*, *Phlogacanthus rectiflorus* J.B. Imlay, *P. vitellinus* T. Anders.

Subtribe Barleriinae (15 species), *viz. Barleria biloba* Imlay, *B. cristata* L., *B. lupulina* Lindl., *B. prionitis* L., *B. siamensis* Craib, *Chroethes bracteata* (J.B. Imlay) B. Hansen, *C. lanceolata* (T. Anders.) B. Hansen, *Lepidagathis chiengmaiensis* Bremek., *L. chlorostachya* Nees, *L. dissimilis* Imlay, *L. falcata* Nees, *L. fasciculata* Nees, *L. incurva* Ham. ex D.Don, *L. purpuricaulis* Nees ex Wall

Morphological features of representarive seeds of the subtribe Barleriinae and Andrographinae, Family Acanthaceae have been described as ovoid and strongly compressed or compressed. The features of testa were recognized. The seed testa were found in various species, *viz* rugulose-tubercle (*Andrographis laxiflora*), rugulose (*Gymnostachyum leptostachyum*), finely tuberculate (*Phlogacanthus pedunculatus*), finely scaled (*Barleria cristata*, *B. lupulina*), coarsely scaled (*B. strigosa*, *Lepidagathis dissimilis*, *L. falcata, L. fasciculata*, *Phlogacanthus pulcherrimus*); sub-orbicular (*Lepidagathis falcata*, *L. incurva*). The features of seed shape vary in different species, *viz* ovoid group (*Andrographis laxiflora*, *Barleria cristata*, *B. strigosa*, *Gymnostachyum leptostachyum*, *Lepidagathis dissimilis*, *L. fasciculate*, *Phlogacanthus pedunculatus*, *P. pulcherrimus*); ellipsoid (*Barleria lupulina*, *Phlogacanthus curviflorus*).

The pollen types of Acanthaceae had been divided into eight distinct pollen types viz.,

Pollen shape type-I (prolate spheroidal): *Andrographis laxiflora*, *Lepidagathis falcate*, *Phlogacanthus pauciflorus*.

Pollen shape type-II (oblate spheroidal): *Aandrographis paniculata*, *Phlogacanthus rectiflorus*.

Pollen shape type-III (oblate): *Chroesthes lanceolata*, *Gymnostachyum signatum*, *G. trilobum*, *G. venustum*.

Pollen shape type-IV (subspheroidal): *Barleria cristata*, *B. lupulina*, *B. prionitis*, *B. siamensis*, *B. strigosa*.

Pollen shape type-V (suboblate): *Phlogacanthus paniculatus*, *P. pulcherrimus*.

Pollen ornamentation type-I (reticulate tectum): *Andrographis laxiflora*.

Pollen ornamentation type-II (open reticulate tectum): *Andrographis paniculata*, *Barleria cristata*, *B. lupulina*, *B. prionitis*, *B. siamensis*, *B. strigosa*.

Pollen ornamentation type-III (reticulate with granulate in lumina): *Gymnostachyum signatum.*

Pollen ornamentation type-IV (finely Reticulate tectum with granulate in lumina): *Gymnostachyum trilobum*.

Pollen ornamentation type-V (reticulate tectum with distinct aperture margin): *Gymnostachyum venustum*.

Pollen ornamentation type-VI (open reticulate tectum, granulate in lumina): *Lepidagathis falcata*.

Pollen ornamentation type-VII (finely Reticulate tectum with distinct aperture margin): *Phlogacanthus paniculatus*, *P. pauciflorus*, *P. pulcherrimus*, *P. rectiflorus*.

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APPENDIX

SPECIMEN EXAMINED

Subtribe Andrographinae

Andrographis laxiflora Lindau

A.F.G. Kerr 4549, 9 Nov. 1920, Kamphaengphet, Ban Klong Pong (BK); *A.F.G. Kerr* 9137, 11 Sept. 1924, Saraburi, Muak Lek (BK); *A.F.G. Kerr* 10307, 26 Jan. 1926, Kanchanaburi, Wangka (BK); *A.F.G. Kerr* 12403, 21 Mar. 1927, Suratthani, Song Pi Nong (BK); *A.F.G. Kerr* 13176, 5 Aug. 1927, Suratthani, Ban Kop (BK); *B. Hansen et al.* 16786, 19 Jan. 1964, Chiang Mai, Omkoi, Bo Luang (BK); *C. Chantharaprasong* 13696, 4 Apr. 2003, Ranong, Khuraburim Koh Phra Thong (BKF); *C. Chermsirivathana* 1027, 14 Nov. 1968, Loei, Ban Na Luang; *C.F. van Beusekom et al.* 4152, 11 Dec. 1971, Chiayaphum, Nam Phrom (BKF); *D.J. Collins* 1675, 25 Oct. 1927, Chonburi, Siracha (BK); *G. Murata et al.* 50876, 14 Nov. 1984, Sakon Nakhon, Phu Phan (BKF); *H.B.G. Garett* 1074, 8 Feb. 1936, Chiang Mai, Chom Thong (BKF); *H. Koyama et al.* 30865, 12 Dec. 1982, Mukdahan, Dong Man (BKF); *H. Koyama et al.* 31125, 16 Dec. 1982, Nongkhai, Sangkhom (BKF); *H. Koyama et al.* 31818, 27 Dec. 1982, Phetchabun, Nam Nao National Park (BKF); *H. Koyama et al.* 32597, 16 Jan. 1983, Mae Hong Son, Pai (BKF); *K. Iwatsuki et al.* 9717, 15 Sept. 1967, Chiang Rai, Phan, Doi Pa Hom Pok (BKF); *K. Larsen et al.* 3034, 11 Aug. 1968, Nakhon Ratchasima, Pak Thong Chai, Khao Yai Nat. Park (BKF); *Maxwell* 71-705, 5 Nov. 1971, Sukhothai, Muang Kao (BK); *Maxwell* 93-993, 28 Aug. 1995, Lampoon, Mae Tha (BKF;CMU); *Maxwell* 95-1011, 25 Oct. 1995, Lampng, Wang Nua (BKF;CMU); *Maxwell* 06-21, 14 Jan. 2006, Krabi, Klong Thom (CMU); *M.C. Lakshnakara* 1428, 8 Dec. 1933, Chiang Mai, Mae Klang (BK); *M. Tagawa et al.* 9120, 4 Sept. 1967, Lamphun, Doi Khun Tan (BKF); *O. Petmitr* 116, Payao, Doi Luang Nat. Park (CMU); *Prayad* 970, 8 Aug. 1967, Chiang Rai, Ban Nam Lod (BK); *P. Sangkhachand* 3454, 20 Oct. 1975, Kalasin, Somdet (BK); *P. Srisanga & C. Puff* 1108, 18 Sept. 1999, Nan, Tham Pha Toop (QBG); *R. Pooma* 1229, Phitsanulok, Romklao (BKF); *T. Shimizu et al.* 8124, 25 Aug. 1967, Phangnga, Takua Thung (BKF); *T. Shimizu et al.* 22391, 12 Nov. 1979, Uthaithani, Lan Sak, Khao Nang Rum Station (BKF); *T. Smitinand* 4906, 22 Nov. 1958, Khon Kaen, Chumphae, Dong Lan (BKF); *Y. Paisooksantivattana* 2286-88, 9 Nov. 1988, Tak, Mae Sod, Doi Dinki (BK)

Andrographis paniculata (Burm.) Nees

A. Rungmakarat 20, 19 Jan. 1981, Chiang Mai, Muang (CMU); *Anupong* 10, 15 Sept. 1979, Songkla, Khao Noi (PSU); *A. Wattananupong* 14, 15 Sept. 1991, Suratthani, Muang (PSU); *B. Hansen &* T. *Smitinand* 12195, 10 Nov. 1966, Ko Talibong (BKF); *C. Chermsirivathana* 76, 20 Aug. 1964, Bangkok (BK;BKF); *Chirayupin* 27, 18 May 1960, Songkla, Hat Yai, Kho Hong (BK); *K. Larsen et al.* 41294, 13 Nov. 1990, Trang, Khao Chong (BKF;PSU); *Maxwell* 74-159, 17 Feb. 1974, Saraburi, Samlan Forest (BK); *Maxwell* 84-291, 5 Oct. 1984, Songkla, Muang (BKF;PSU); *Maxwell* 86-586, 13 Aug. 1986, Phattalung, Kuan Kanoon (BKF;PSU); *Maxwell* 88-1069, 10

Sept. 1988, Chiang Mai, Muang (BKF); *Maxwell* 03-490, 8 Dec. 2003, Chonburi, Siracha (CMU); *P. Sirirugsa* 1148, 1 Jan. 1988, Krabi, Muang (PSU); *P. Sirirugsa* s.n., Sept. 1973 (PSU); *R. Pooma et al.* 3029, 30 Aug. 2001, Saraburi, Muek Lek (BKF); *S. Barakoranode* 226, 17 Feb. 1982, Chaing Mai, Sansai (CMU); *T. Shimizu et al.* 27756, 20 Dec.1979, Phattalung, Ban Pak Klong (BKF); *T. Nairaksar* 57, 5 Jan. 1989, Songkla, Hat Yai (PSU); *T. Smitinand* s.n., 26 Sept. 1979, Saraburi, Hinlap (BKF); *W. Nanakorn et al.* 5098, 5 Nov. 1995, Loei, Na Heaw, Tat Hueng Falls (QBG)

Graphandra procumbens J.B. Imlay
A.F.G. Kerr 8454, 18 Feb. 1924, Nakhon Phanom, Tha Uten (Isotype) (BK); (Holootype) (K).

Gymnostachyum canescens (Nees) T. Anders.
B. Sangkhachand 760, 10 Feb. 1959, Kanchana Buri, Sai Yok District (BKF);
F. konta & C. Phengklai 4055, 7 Feb. 1998, Chiang Mai, Chom Thong (BKF)

Gymostachyum coriaceum J.B. Imlay
A.F.G. Kerr 8498, 18 Feb. 1924, Sakon Nakhon, Wanonniwat (Isotye) (BK)

Gymnostachyum decurrens Stapf
Put 4116, 6 Sep. 1931, Surat Thani, Khantuli (BK)

Gymnostachyum gracile C. B. Clarke
Sørensen T.et al. 588, 24 Jan. 1958, Phathalung, Chong Forest Station (BKF)

Gymnostachyum leptostachyum, Nees
Ch. Charoenphol et al. 3637, 11 Oct. 1970, Trang, Nam Tai (BKF); *C.F. van Beusekom & C.P.R. Geeshink* 3736, 12 Nov. 1971, Kanchana Buri, Huay Bankan (BKF); K. Iwats. et al. 14494, 20 Aug. 1967, Nakhon Si Thammarat, Wat Kiriwong (BKF); *T. Shimitzu et al*. 26216, 6 Dec. 1979, Ranong, Hot Spring Park (BKF); *T.S. & R.G. Robbins* 7883, 18 Nov. 1962, Khao Yai National Park (BKF)

Gymnostachyum signatum (R. Ben.) J. B. Imlay
A.F.G. Kerr 6448, 25 Oct. 1922, Chiang Mai, Mae Rim (BK); *A. Marcan* 1527, 29 Dec. 1923, Pakchong (BK); *C. Chermsirivathana* 1028, Loei, Ban Na Luang (BK); *C. Phengklai et al.* 3898, 24 Nov. 1977, Kamphaengphet, Ban Nam Tok, Khao Son (BKF); *H. Koyama et al.* 31799, 27 Dec. 1982, Phetchabun, Nam Nao Nat. Park, Pha Hong Cave (BKF); *Maxwell* 74-837, 24 Aug. 1974, Saraburi, Samlan Forest (BK); *Maxwell* 75-1061, 20 Oct. 1975, Chonburi, Siracha, Kow Kieo (BK); *Maxwell* 76-700, 24 Oct. 1976, Chonburi, Ban Bung, Khao Chomphu (BK); *Prayad* 885, 3 Jul. 1967, Chiang Rai, Mae Suai, Ban San Sa At (BK); *Prayad* 887, 4 Jul. 1969, Chiang Rai, Mae Suai, Ban San Sa At (BK); *Put* 1896, 5 Sept. 1928, Saraburi, Muak Lek (BK); *Th. Sorensen et al.* 6111, 22 Nov. 1958, Chumphae, Dong Lan (BKF)

Gymnostachyum trilobum Ridley
A.F.G. Kerr 11520, 18 Jan. 1927, Chumporn, Kao Tong (BK); *A.F.G. Kerr* 16741, 19 Jan. 1929, Ranawng, Kao Pawta Chongdong (BK); *A.F.G. Kerr* 17439, 11 Mar. 1929,

Puket, Talang (BK); *A.F.G. Kerr* 18129, 19 Feb. 1930, Surat, Ban Pa (BK); *B. Hansen & T. Smitinand* 11993, 18 Jan. 1966, Nai Chong, Khao Ao Khuan (BKF); *H. Koyama et al.* 33124, 30 Jan. 1983, Prachinburi, Srakaew, Chakan Aboretum (BKF); *H. Koyama et al.* 33892, 1 May 1983, Ranong, Kaper, Khlong Nakha Wildlife Sanctuary (BKF); *J. Sadakorn s.n.*, 5 Mar. 1972, Phangnga, Tap Put (BK); *Maxwell* 87-172, 6 Feb. 1987, Suratthani,Kiriratnikom (BKF); *Maxwell* 87-294, 4 Apr. 1987, Pattalung, Sibahnpote, Riang Tong Falls (BKF); *P. Suvarnakoses* 1627, 19 Feb. 1961, Trang, Huai Yot (BKF)

Gymnostachyum venustum (Wall.) T. Anders.
A.F.G. Kerr 10327, 29 Jan. 1926, Kanburi, Wangka (BK)

Phlogacanthus abbreviatus (Craib) R.Ben.
A.F.G. Kerr 4888, 21 Feb. 1921, Nan, Hue Pa (BK)

Phlogacanthus asperulus Nees
Maxwell 96-513, 1Apr. 1996, Lampang Province, Muang Pan (BKF)

Phlogacanthus brevis C.B. Clarke
Maxwell 85-500, 18 May 1985, Nakhonsi Thammarat, Lan Saka, Karom Falls (PSU); *P. Nitrasirirak* 252, Jul. 1972, Narathivat, Waeng (BKF)

Phlogacanthus curviflorus (Wall.) Nees
F. van Beusekom et al. 3666, Kanchanaburi, Huay Ban Kau (BKF); *C.F. van Beusekom* 4653, 5 Jan. 1972, Phrae (BKF); *C. Phengklai et al.* 3919, 25 Nov. 1977, Kamphaengphet, Dong Lan Falls (BKF;PSU); *H.B.G. Garett* 833, 18 Nov. 1933, Chiang Rai, Mae Suai, Doi Langka (BKF); *K. Iwatsuki & N. Fukuoka* 3502, Chiang Rai, Ban Lang Lat, Nam Mae Lao (BKF); *K. Larsen et al.* 41918, 13 Dec. 1990, Nan, Doi Phu Kha (BKF;PSU); *Maxwell* 97-1460, 4 Dec. 1997, Chiang Rai, Wiang Papao (BKF;CMU); *R. Pooma* 1246, 11 Nov. 1995, Nan Doi Phu Kha (BKF); *T. Smitinand* 735, 21 Feb. 1958, Chiang Mai, Chiang Dao (BKF); *T. Smitinand & P. Sowo* 7951, 6 Dec. 1962, Tak, Doi Musor (BKF); *Th. Wongprasert* 0312-07, 25 Dec. 2003, Mae Hong Son (BKF); *Th. Wongprasert & S. Khao-Iam* 0212-13, 15 Dec. 2002, Phrae, Muang, Ban Nam Phra (BKF)

Phlogacanthus murtonii Craib
Bunnak 598, 17 Feb. 1956, Chantha Buri, Pong Nam Ron District (BKF); *T. Smitinand* 3187, 18 Jan. 1956, Chantha Buri, Pong Nam Ron District, Ban Pra Tong (BKF)

Phlogacanthus paniculatus (T. Anders.) J. B. Imlay
A.F.G. Kerr 4878, 25 Feb. 1921, Nan, Doi Phu Kha (BK); *A.F.G. Kerr* 5960, 6 May 1928, Kamphaengphet (BK); *C. Phengklai* 57, 22 Mar. 1961, Phrae, Huay Lao Puen (BKF); *E. Hennipman* 3622, 10 Jan. 1966, Loei, Phu Luang (BKF); *K. Bunchuai* 1608, 8 Feb. 1968, Loei, Phu Luang (BKF); *Maxwell* 74-93, 24 Jan. 1974, Sukhothai, Muang Kao (BK); *Maxwell* 89-279, 20 Feb. 1989, Chiang Mai, Hot, Obluang Nat. Park (BKF); *M. Tagawa et al.* 1073, 3 Dec. 1965, Loei, Phulang, Ban Na Luang (BKF); *Tem & Williams* 17126, 16 Oct. 1952, Phrae, Mae Krating (BKF); *T. Shimizu*

et al. 22380, 12 Nov. 1979, Uthaithani, Khao Nang Rum Res. Station (BKF); *Winit* 1899, 1 Mar. 1929, Lampang, Mae Sala (BKF)

Phlogacanthus pauciflorus J.B. Imlay
F. Floto 6657, 22 Jan. 1959, Tak (BKF); *Maxwell* 04-103, 25 Feb. 2004, Lamphun, Pa Sang, Erawan Cave (CMU)

Phlogacanthus pedunculatus J.B. Imlay
A.F.G. Kerr 4797, 5 Feb. 1921, Lampang, Chae Hom (BK); *A.F.G. Kerr* 10200, 13 Jan. 1926, Kanchanaburi, Sisawat (BK); *Cheviwat & B. Nimanong* 27, 15 Jan. 1969, Tak, Lan Sang (BKF); *K. Larsen* 9237, 24 Jan. 1962, Kanchanaburi, Sai Yok (BK); *T. Shimizu et al.* 22380, 12 Nov. 1979, Uthaithani, Khao Nang Rum Res. Station (BKF); *T. Smitinand* 3708, 6 Feb. 1957, Lamphun, Li (BKF)

Phlogacanthus pulcherrimus T. Anders.
A.F.G. Kerr 8303, 15 Jan. 1924, Sangka, Surin (BK); *A.F.G. Kerr* 9465, 28 Nov. 1924, Trat, Ban Rai (BK); *A.F.G. Kerr* 16305, 23 Dec. 1928, Chumporn, Tasae (BK); *A.F.G. Kerr* 17041, 7 Feb. 1929, Takuapa (BK); *C. Niyomdam & R. Kubat* 1408, Khlong Nakha Nat. Park (BKF); *H. Koyama et al.* 33889, 1 Mar. 1983, Ranong, Khlong Nakha Wildlife Sanctuary ((BKF); *Put* 1554, 13 Mar. 1928, Bang Son (BK); *J.E. Vidal* 5776, 20 Nov. 1971, Trat Nong Bon (BK); *S. Sutheesorn* 2198, 12 Apr. 1967, Chumporn, Kapok Falls (BK)

Phlogacanthus racemosus Bremek.
Maxwell 95-21, 22 Jan. 1995, Sukkhothai, Ramkhamhaeng Nat. Park (BKF); *Maxwell* 95-144, 19 Feb. 1995, Lampang, Doi Khun Tan (BKF); *Maxwell* 97-104, 1 Feb. 1997, Chiang Mai, Doi Saket (BKF); *Maxwell* 97-187, 4 Mar. 1997, Chiang Mai, Sankamphaeng (BKF;CMU); *M. Panatkool* 107, 7 Sept. 1996, Lampang, Muang Pan (CMU); *M. van de Bult* 40, 28 Oct. 1997, Kamphaengphet, Klong Lan (BKF;CMU); *O. Petmitr* 267, 23 Jan. 1998, Payao, Doi Luang (BKF)

Phlogacanthus rectiflorus J.B. Imlay
A.F.G. Kerr 17233, 24 Feb. 1929, Pungnga, Bangto (Isotype) (BK); *C. Chermsirivathana* 1540, Jun. 1969, Pathumthani (BK); *H. Terao* 33728, 26 Feb. 1983, Ranong, Kaper (BKF)

Phlogacanthus vitellinus T. Anders.
K. Twats. & N. Fukuoka T-7094, 7 Feb. 1966, Chantha Buri, Khao Soi Dao (BKF);
T. Shimizu et al. T-23638, 26 Nov. 1979, Chantha Buri, Khao Soi Dao (BKF);
T. Shimizu et al. T-23893, 28 Nov. 1979, Chantha Buri, Khao Soi Dao (BKF);
T. Shimizu et al. T-26006, 29 Nov. 1979, Chantha Buri, Khao Soi Dao (BKF)

Subtribe Barleriinae

Barleria biloba J.B. Imlay
A.F.G. Kerr 7997, 15 Dec. 1923, Lopburi, Chaibadan (BK); *Sangkhachand* 1060, 10 Nov. 1964, Prachuap Kirikhan, Khao Sam Roi Yot (BKF); *Put* 2508, 2 Dec. 1928, Sam Roi Yawt (BK)

Barleria cristata L.

Adisai 941, 10 Nov. 1964, Prachuap Khirikhan, Kha Noi (BK); *A.F.G. Kerr* 19773, 19 Jan. 1926, Kanchana Buri, Tha Khanun (BK); *A.F.G. Kerr* 10268, 19 Oct. 1930, Kanchana Buri, Kao Tawng (BK); *Anonymous,* 27 Nov. 1969, Chaing Rai, Doi Nom (BKF); *B. Nimanong et al*. 110, 10 Dec. 1967, Chantha Buri (BKF); *B. Sangkhachand* 1060, 10 Nov. 1964, Prachuap Khirikhan, Sam Roi Yot (BKF); *C.F. van Beusekom et al*. 2323, 5 Dec. 1969, Chiang Mai, Doi Inthanon (BKF); *C.F. van Beusekom et al.* 3437, 5 Nov. 1971, Kanchana Buri, Sisawat (BKF); *C.F. van Beusekom et al.* 3560, Kanchana Buri, Huai Ban Kao (BKF); *C.F. van Beusekom* et al 3672, 11 Nov. 1971, Kanchana Buri, Huai Ban Kao (BKF); *C. Hambananda* 242, 27 Jan. 1965, Lampang, Huai Prao (BKF); *C. Niyomdham* 6393, 19 Dec. 2000, Tak, Aumpang (BKF); *C. Phengklai et al*. 3902, 24 Nov. 1977, Kamphaengphet, Khao Son (BKF); *C. Phengklai et a*l. 6057, Nov. 1986, Chiang Mai, Doi Inthanon (BKF); *E. Hennipman* 3221, 5 Dec. 1965, Chiang Mai, Chiangdao (BKF); *F. Konta et al*. 4225, Chiang Mai, Mae Chaem (BKF); *F. Konta et al*. 4477, 13 Dec. 1998, Mae Hong Son, Pai (BKF); *F. Konta et al*. 4495, 15 Dec. 1998, Chom Thong, Mae Ya Water Fall (BKF); *F. Konta et al.* 4614, 18 Jan. 1974, Tak (BKF); *G. Murata et al.* 15393, 30 Sep. 1971, Chiang Mai, Chomthong (BKF); *G. Murata et al*. 15414, 1 Oct. 1971, Chiang Mai, Sop Aep (BKF); *G. Murata et al*. 15417, 1 Oct. 1971, Chiang Mai, Mae Klang Fall (BKF); *G. Murata et al*. 51528, 28 Oct. 1984, Loei, Nam Nao (BKF); *G. Murata et al.* 50053, 8 Nov. 1984, Chaiyaphum, Phu Khieo (BKF); *G. Murata et al*. 51605, 26 Oct. 1984, Loei, Nam Nao (BKF); *G. Murata et al*. 51607, Loei, Nam Nao (BKF); *H. Koyama* T-62062, 9 Jan. 1994, Lampang, Doi Khun Tan (BKF); *H. Koyama et al*. 30157, 20 Nov. 1982, Nakhon Ratchasima, Pakchong (BKF); *H. Koyama et al.* 30338, 26 Nov. 1982, Kanchana Buri, Si Sawat (BKF); *H. Koyama et al*. 31713, 26 Dec. 1982, Phetchabun, Nam Nao (BKF); *H. Koyama et al*. 30457, 29 Nov. 1982, Kanchana Buri, Khao Laem Dam (BKF); *H. Koyama et al*. 30506, 14 Jan. 1983, Kanchana Buri, Tham Than Rot (BKF); *H. Koyama et al*. 32112, 8 Jan. 1983, Chiang Mai, Mae Chaem (BKF); *H. Koyama et al.* 32183, 9 Jan. 1983, Chiang Mai, Hod (BKF); *H. Koyama et al.* 32240, 10 Jan. 1983, Chiang Mai, Om Koi (BKF); *H. Koyama et al*. 32296, 14 Jan. 1983, Chiang Mai, Hod (BKF); *H. Koyama et al.* 32423, 13 Jan. 1983, Chiang Mai, Hod (BKF); *H. Koyama et al.* 32475, 14 Jan. 1983, Mae Hong Son, Tham Pla (BKF); *H. Koyama et al*. 32592, 16 Jan. 1983, Mae Hong Son, Pai (BKF); *H. Koyama et al.* 32755, 19 Jan. 1983, Chiang Mai, Doi Mae Ya (BKF); *H. Koyama et al*. 33247, 9 Feb. 1983, Chiang Mai, Doi Chiangdao (BKF); *H. Koyama et al*. 39104, 27 Dec. 1984, Lampang, Doi Khun Tan (BKF); *H. Koyama et al.* 39670, 28 Nov. 1984, Chiang Mai, Mae Taman (BKF); *H.B.G. Garrett* 901, 28 Nov. 1934, Chiang Mai, Mae Klang (BKF); *H. Takahashi 62972*, 18 Jul. 1988, Chiang Mai, Mae Khae Waterfall (BKF); *Jackson* 6195, 3 Oct. 1974, Chiang Mai, Mae Sa Valley (BKF); *K. Bunchuai 105*, 1 Jan 1962, Chaing Mai, Doi Chiang Dao (BKF); *K. Bunchuai* 1197, 14 Nov. 1962, Ching Mai, Doi Chiangdao (BKF); *K. Bunchuai* 1345, 21 Nov. 1963, Chiang Mai, Chiangdao (BKF); *K. Bunchuai 53*, 8 Dec. 1960, Chaing Mai, Doi Chiang Dao (BKF); *K. Chayamarit* 1139, 13 Dec. 1997, Chiang Rai (BKF); *K. Iwatsuki et al.* T-3475, Chiang Ria, Ban Langlat along Nam Mae Lao (BKF); *K. Larsen et al.* 41331, 13 Nov. 1990, Trang, Khao Chong (BKF); *Laksanakara* 1412, 7 Dec. 1933, Chiang Mai, Mae Klang (BK); Maxwell 87-58, 16 Jan. 1987, Chumporn, Thasae (BKF); *Maxwel*l 97-1314, 8 Nov. 1997, Chiang Mai, Mae Taeng (BKF); *Maxwell 87-1229*, 21 Oct. 1987, Chiang Mai, Doi Suthep (BKF); *Maxwell* 74-86, 23

Jan. 1974, Sukhothai, Muang Kao (BK); *Maxwell 97-1341*, 10 Nov. 1997, Chiang Mai, Mae Taeng (BKF); *Maxwell* 97-1431, 2 Dec. 1997, Chiang Rai, Wiang Pa Pao (BKF); *M. Boonbrahm* 6, 10 Sep. 1954, Bangkok, Lumpini Park (BK); *M. Tagawa et al*. 3159, 21 Dec. 1965, Chiang Mai, Mae Klang (BKF); *O. Petrmitr* 211, 27 Dec. 1997, Payao, Doi Luang (BKF); *P. Sangkhachand* 8, 8 Nov. 1965, Chiang Mai, Mae Klang Falls (BK); *P. Sangkhachand* 36, 11 Nov. 1965, Chiang Mai, Mae Klang Falls (BK); *Put* 402, 19 Oct. 1926, Chiang Mai, Doi Chingdao (BK); *Put* 4425, 20 Dec. 1931, Chiang Mai, Doi Chiangdao (BK); *Sakol Suthisorn* 3103, 27 Oct. 1974, Uthai Thani, Ban Rai (BK); *Sakol Suthisorn* 4202, 9 Sep. 1977, Chiang Mai, Phrao (BK); Suradej 223, 18 Sep. 1984, Chiang Mai, Doi Suthep (BKF); *TDBS 4799*, Chiang Mai, Doi Suthep (BKF); *TDBS* 10780, 19 Mar. 1964, Chiang Mai, Om Koi (BKF, BK); *T. Shimizu et al.* 10430, 18 Sep. 1967, Chiang Mai, Doi Suthep (BKF); *T. Shimizu et al.* 17905, 6 Oct. 1979, Saraburi, Na Pra Lan (BKF); *T. Shimizu et al.* 18723, 14 Oct. 1979, Chiang Mai, Doi Suthep (BKF); *T. Shimizu et al* 18727, 14 Oct. 1979, Chiang Mai, Doi Suthep (BKF); *T. Shimizu et al*. 22268, 12 Nov. 1979, Lansak (BKF); *T. Shimizu et al.* 22369, Uthai Thani, Lansak (BKF); *T. Smitinand* 7067, 9 Dec. 1960, Tak, Doi Musor (BKF); *T. Smitinand*, 2 Dec. 1983, Chiang Mai, Doi Tao (BKF); *Th. Santisuk* 138, 6 Sep. 1968 (BKF); *Th. Santisuk 6653*, Chiang Mai, Om Koi (BKF); *Th. Sorensen et al*. 7296, Bangkok (BKF); *Th. Wongprasert*, 17 Oct. 1999, Chiang Mai, Chomthong (BKF); *W. Nanakorn* 303, 12 Feb. 1984, Chiang Mai, Chiangdao (BKF); *Winit* 1567, 15 Nov. 1925, Lamphun, Li (BKF, BK); *Y. Paisooksantivatana* Y354-80, 6 Nov. 1980, Mae Hong Son, Mae Saring (BK); *Y. Paisooksantivatana* 1997-86, 24 Dec. 1986, Burma, Chan State (BK)

Barleria lupulina Lindl.
Anonymous, 27 Feb. 1967 (BKF)*; Anonymous*, 16 Mar. 1923, Bangkok (BK); *Anonymous*, 15 Nov. 1923, Bangkok (BK); *Anonymous*, Sep. 1927, (BK);*A. Suksamrarn*, 15 Jun. 1985, Bangkok, Phra Khanong (BKF); *D.J. Collins* 939, 9 Aug. 1923, Bangkok (BK); *H. Koyama* 30237, 22 Nov. 1982, Nakhon Nayok, Nang Rong (BKF); *R. Pooma* 1238, 10 Nov. 1995, Nan, Tham Phatoop (BKF); Sanchai 664, Dec. 2502, Tak, Bhumibol Dam (BK)

Barleria prionitis L.
Anonymous, 27 Feb. 1967 (BKF); *C.F. van Beusekom et al*. 3796, Kanchana Buri, Ban Kao (BKF); *C. Niyomdham*, 17 Jan. 1989, Kanchana Buri, Sanghkla Buri (BKF); *D.J. Collins* 2006, 11 Nov. 1927, Chon Buri, Siracha (BK); *Phornchit* 302, 8 Mar. 1952, Nakhonsi Thammarat, Khiriwong (BKF); *K. Chayamarit et al*. 3014, 8 Jan. 2002, Phet Buri, Cha-am (BKF); *Put* 2045, 20 Oct. 1928, Sa Kaeo, Aranya Prathet (BK); *Maxwell* 72-403, Phetburi, Muang (BK); *Sakol Suthison* 2746, 27 Dec. 1973, Phetburi, Wat Khao Tha Phrao (BK); *Samruay et al. 155*, 1 Apr. 1975, Kanchana Buri, Si Sawat (BKF); *S. Indrapong et al*. 155, 1 Apr. 1975, Kanchana Buri (BKF); *T. Shimizu et al*. 27349, 15 Dec. 1979, Phangnga, Suwan Khuha Cave (BKF); *Y. Paisooksantivatana* Y606-81, 18 Feb. 1981, Bangkok, Bangkhen (BK)

Barleria siamensis Craib
Dee 993, 27 Nov. 1957, Loei, Phu Luang (BKF); *G. Murata et al*. 50617, 13 Nov. 1984, Sakonnakhon, Phu Phan (BKF); *G. Murata et al*. 51221, 12 Nov. 1984, Sakonnakhon, Phu Phan (BKF); *H. Koyama et al*. T-30285, 25 Nov. 1982, Kanchanaburi, Erawan National Park (BKF); *H. Koyama et al*. 30300, 26 Nov. 1982,

Kanchana Buri, Erawan National Park (BKF); *H. Koyama et al*. T-30329, 26 Nov. 1982, Kanchanaburi, Erawan National Park (BKF); *H. Koyama et al*. T-30479, 30 Nov. 1982, Kanchanaburi, Tham Than Lot (BKF); *H. Koyama et al*. T-31698, 26 Dec. 1982, Phetchabun, Nam Nao (BKF); *H. Koyama et al*. T-31881, 28 Dec. 1982, Phetchabun, Thung Salaengluang (BKF); *H. Koyama et al*. T-31935, 29 Dec. 1982, Chiang Rai, Maesai (BKF); *H. Koyama et al*. 33149, 6 Feb. 1983, Chiang Mai, Doi Chiangdao (BKF); *H. Koyama et al*. T-33512, 14 Feb. 1983, Chiang Rai, Maesai (BKF); *H. Koyama et al*. 34097, 6 Mar. 1983, Prachuap Khirikhan, Huai Yang Falls (BKF);. *H.B.G. Garrett* 95, 28 Oct. 1910, Chiang Mai, Doi Angka (BKF); *K. Bunchuai* 43, Chiang Mai, Doi Chiangdao (BKF); *K. Chayamarit et al*. 714, 19 Mar. 1997, Chiang Mai, Doi Suthep (BKF); *Maxwell* 95-950, 212 Oct. 1995, Lampang, Muangpan (BKF); *M. Tagawa et al*. 1048, 3 Dec. 1965, Loei, Phu Luang (BKF); *N. Fuguoka & H. Koyama* T- 62131, 10 Jan. 1994, Chiang Mai, Doi Suthep (BKF); *TDBS* 5428, Chiang Mai, Doi Suthep (BKF); *T. Shimizu et al*. T-18349, 11 Oct. 1979, Phitsanulok, Thung Salaengluang (BKF); *T. Shimizu et al*. T-18424, 12 Oct. 1979, Tak, Khao Phra Wo (BKF); *T. Shimizu et al*. T-18426, 12 Oct. 1979, Tak, Khao Phra Wo (BKF); *T. Shimizu et al.* T-18457, 12 Oct. 1979, Tak, Khao Phra Wo (BKF); *T. Shimizu et al*. 19312, 18 Oct. 1979, Chiang Mai, Omkoi (BKF); *T. Shimizu et al*. T-21519, 3 Nov. 1979, Kanchanaburi, Erawan National Park (BKF); *T. Shimizu et al*. T-21524, 3 Nov. 1979, Kanchanaburi, Erawan National Park (BKF); *T. Shimizu et al*. T-21627, 3 Nov. 1979, Kanchanaburi, Erawan National Park (BKF); *T. Shimizu et al.* T-21965, 7 Nov. 1979, Kanchanaburi, Tham Than Lot (BKF); *T. Shimizu et al*. T-22001, 7 Nov. 1979, Kanchanaburi, Tham Than Lot (BKF); *Th. Wongprasert*, Kanchanaburi, Linthin (BKF); *Th. Wongprasert*, 25 Aug. 1999, Kanchanaburi, Linthin (BKF); *Th. Wongprasert*, 24 Nov. 1997, Nan, Doi Phukha (BKF); *T. Smitinand & Th. Santisuk* 497, 28 Feb. 1993 (BKF)

Barleria strigosa Willd.
Adisai 606, 6 Nov. 1963, Chiang Mai, Chinagdao (BK); *A.F.G. Kerr*, 28 Jan. 1923, Bangkok (BK); *A.F.G. Kerr*, 14 Jan. 1927, Chumphon, Map Ammarit (BK); *A.F.G. Kerr* 9091, 1 Sep. 1924, Nakhon Ratchasima, Chan Tuk (BK); *A.F.G. Kerr* 11561, 19 Jan. 1927, Chumphon, Ta Ngaw (BK); *A.F.G. Kerr* 19598, 9 Aug. 1930, Aranya Prathet (BK); *A.F.G. Kerr* 19665, 18 Sep. 1930, Chainat, Kao Tamnammon (BK); *A.F.G. Kerr* 19831, 10 Nov. 1930, Prachinburi, Krabinburi (BK); *Anonymous* 228, 28 Aug. 1966, Chaiyaphum, Pa Huai Yai Chiu (BKF); *Anonymous* 2323, 2 Nov. 1960, Chiang Mai, Ban Aen (BK); *B.N. & S.P.* 296, 17 Aug. 1968, Kanchana Buri, Khao Salop (BKF); *B. Sangkhachand* 1616, 8 Dec. 1969, Kanchana Buri, Si Sawat (BKF); *C. Chermsirivathana* 179, 24 Oct. 1964, Prachuap Khirikhan, Huai Yang (BK); *C. Chermsirivathana* 187, 21 Dec. 1964, Khon Kaen (BK); *C.F. van Beusekom et al*. 1865, 28 Oct. 1969, Nakhon Ratchasima, Pak Thong Chai (BKF); *C.F. van Beusekom et al*. 2068, 9 Nov. 1969, Chanthaburi, Khao Soi Dao (BKF); *C.F. van Beusekom et al.* 3842, 18 Nov. 1971, Kanchanaburi, Erawan National Park (BKF); *C. Hambananda* 368, 2 Oct. 1968, Nakhon Ratchasima, Pak Thong Chai (BKF); *C.H.* 228, 13 Aug. 1964, Lampang, Tham Pha Thai (BKF); *C. Noophakdee* 27, Saraburi, Phra Phutthabat (BKF); *C. Phengklai* 583, 18 Dec. 1962, Nakhon Ratchasima (BKF); *C. Phengklai et al*. 3429, 26 Nov. 1976, Buriram (BKF); *C. Phengklai et al*. 3895, 24 Nov. 1977, Kamphaengphet, Ban Nam Tok (BKF); *Damrongsak* 162, 27 Aug. 1967,

Nakhon Ratchasima, Pak Thong Chai (BKF); *Damrongsak* 751, 6 Aug. 1968, Nakhon Ratchasima, Pak Thong Chai (BKF); *D. Bunpheng* 96, 26 Jul. 1967, Loei, Wangsaphung (BKF); *Dee* 16, 22 Oct. 1951, Loei, Wang Saphung (BKF); *Dee* 177, 25 Jul. 1947, Saraburi, Phukae (BKF); *Dee* 348, 12 Sep. 1952, Loei, Phu Kradung (BKF); *Dee* 589, 18 Jul. 1952, Loei, Phu Kradung (BKF); *Din* 102, 30 Jan.1947, Loei, Wangsaphung (BKF); *Din* 137, 27 Jul.1946, Loei, Wangsaphung (BKF); *D.J. Collins* 813, 11 Apr. 1923, Chonburi, Siracha (BK); *G. Murata et al*. T- 14875, Chiang Mai, Wat Chiangdao (BKF); *G. Murata et al*. T-16144, Kanchana Buri, Erawan Falls (BKF); *G. Murata et al*. T-17138, Phitsanulok, Thung Salaeng Luang (BKF); *G. Murata et al.* T-37433, 4 Oct. 1984, Buriram (BKF); *G. Murata et al*. T- 38173, 10 Oct. 1984, Along the Road from Ubon Ratchathani to Si Saket (BKF); *G. Murata et al*. T-38275, Phitsanulok, Thung Salaengluang (BKF); *G. Murata et al.* T-38295, 21 Oct. 1984, Phitsanulok, Thung Salaengluang (BKF); *G. Murata et al*. T-38357, 21 Oct. 1984, Phitsanulok, Thung Salaengluang (BKF); *G. Murata et al*. T-50794, 17 Nov. 1984, Mukdahan, Phu Hinthoep (BKF); *G. Murata et al*. T-51466, 22 Oct. 1984, Phitsanulok, Poi Falls (BKF); *G. Murata & C. Phengklai* T-50416, 15 Nov. 1984, Sakon Nakhon, Phu Phan (BKF); *H. Koyama et al*. T-30638, 9 Dec. 1982, Ubonratcha Thani, Phibunmangsahan (BKF); *H. Koyama et al*. T-30753, 10 Dec. 1982, Ubonratcha Thani, Nachaluai (BKF); *H. Koyama et al*. T-30804, 11 Dec. 1982, Ubon Ratchathani, Muang Samsip (BKF); *H. Koyama et al*. T-30848, 11 Dec. 1982, Mugdahan, Phu Mu (BKF); *H. Koyama et al*. T-30858, 12 Dec. 1982, Mukdahan, Dongman (BKF); *H. Koyama et al*. 30932, 12 Dec. 1984, Mukdahan, Dongman (BKF); *H. Koyama et al*. T-30944, 13 Dec. 1982, Mukdahan (BKF); *H. Koyama et al*. T-31082, 15 Dec. 1982, Nongkhai, Sichiangmai (BKF); *H. Koyama et al*. T-31142, 16 Dec. 1982, Nongkhai, Sangkhom (BKF); *H. Koyama et al*. T-31183, 17 Dec. 1982, Loei, Phu Kradung (BKF); *H. Koyama et al*. T-32472, 14 Jan. 1983, Mae Hong Son, Tham Pla (BKF); *H. Koyama et al*. T-32514, 15 Jan. 1983, Mae Hong Son, Pai (BKF); *H. Koyama et al.* T-32657, 17 Jan. 1983, Mae Hong Son, Pai (BKF); *H. Koyama et al*. T-32663, 17 Jan. 1983, Mae Hong Son, Pai (BKF); *H. Koyama et al*. T-33059, Nakhon Ratchasima, Sakaerat (BKF); *H. Koyama et al*. T-33246, 9 Feb. 1983, Chiang Mai, Doi Chiangdao (BKF); *H. Koyama et al*. 39177, 28 Dec. 1984, Lampang, Doi Khun Tan (BKF); *H. Takahashi* 63148, 26 Aug. 1988, Loei, Ban Na Noi (BKF); *J. Middleton et al*. 935, 10 Aug. 2002, Phetburi, Kaeng Krachan (BKF); *J. Middleton et al*. 1246, 20 Aug. 2002, Prachuap Khirikhan, Pranburi (BKF); *K. Bunchuai* 1289, 27 Oct. 1963, Chiang Mai, Chiangdao (BKF); *K. Bunpan* 51, 7 Dec. 1959, Chiang Mai, Chiangdao (BKF); *K. Bunchuai* 52, 7 Dec. 1977, Chiang Mai, Chiangdao (BKF); *K. Bunpan* 1223, 23 Nov. 1952, Chiang Mai, Chiangdao (BKF); *K. Iwatsuki et al*. T-10321, 18 Sep. 1967, Mae Hong Son, Mae Sariang (BKF); *Kasem* 537, 9 Aug. 1967, Kanchana Buri, Si Sawat (BK); *Kasin Suvatabandhu*, 12 Oct. 1954, Uttaradit, Mohn Si Chaiw (BK); *K. Iwatsuki et al*. T-10964, 24 Sep. 1967, Chiang Rai, Doi Tung (BKF); *K. Larsen et al.* 883, Aug., 1966, Phitsanulok (BKF); *K. Larsen et al.* 1124, Prachin Buri, Ban Bung Hills (BKF); *K. Larsen et al*. 3121, 8 Aug. 1968, Nakhon Ratchasima, Pak Thong Chai (BKF); *K. Larsen et al*. 31406, Chaiyaphum, Thung Kramang (BKF); *Laksanakara* 233, 6 Oct. 1926, Saraburi, Kaeng Khoi (BK); *Laksanakara* 910, 12 Jun. 1932, Ubon Ratchathani (BK); *L.Q. Bao* 13, 10 Nov. 1997, Chiang Mai, Mae Taeng (BKF); *M. Tagawa et al*. 978, 11 Sep. 1967, Chiang Mai, Doi Chiangdao (BKF); *M. Tagawa et al*. 1047, 3 Dec. 1965, Loei, Phu Luang (BKF); *M. Tagawa et al*. T-10626, 23 Sep. 1967, Lampang Tham Pha Thai (BKF); *M.N. Tamura* T-60426, 26 Aug. 1988, Loei, Ban Na Noi (BKF);

Maxwell 73-530, 17 Oct. 1973, Saraburi, Samlan National Park (BK); *Maxwell* 71-680, 5 Nov. 1971, Sukhothai, Muang Kao (BK); *Maxwell* 75-923, 24 Aug. 1975, Nakhon Ratchasima, Pak Thong Chai (BK);*Maxwell* 75-947, 30 Aug. 1975, Chonburi, Siracha (BK); *Maxwell* 87-1166, 10 Oct. 1987, Chiang Mai, Doi Suthep (BKF); *Maxwell* 87-1301, 29 Oct. 1987, Chiang Mai, Chiangdao (BKF); *Maxwell* 95-745, 23 Sep. 1995, Lampang, Muang Pan (BKF); *Nai Noi Mao*, 27 Sep. 1921, Chiang Mai, Phae Pa Daeng (BK); O. *Petrmitr* 113, Payao, Doi Luang (BKF); *Pradit* 389, 9 Aug. 1963, Sakon Nakhon, Phu Phan (BK); *Pradit* 558, 11 Nov. 1963, Nakhon Ratchasima, Pak Thdong Chai (BK); *Prayad* 529, 22 Nov. 1966, Phitsanulok, Thung Salaeng Luang (BK); *Prayad* 576, 8 Dec. 1966, Phitsanulok (BK); *Prayad* 991, 6 Oct. 1967, Loei, Phu Kradung (BK); *P. Sangkhachand* 59, 15 Nov. 1965, Chiang Mai, Mae Klang Falls (BK); *P. Suvarnakoses* 107, Oct. 1954, Chiang Mai, Chiangdao (BKF); *Put* 1000, 7 Sep. 1927, Chumphon, Siepyuan (BK); *Put* 1083, 26 Sep. 1927, Saraburi, Ban Nong Bua (BK); *Put* 2396, 18 Aug. 1929, Saraburi, Hin Lap (BK); *Put* 3125, 14 Sep. 1930, Sa Kaeo, Aranya Prathet (BK); *Put* 4274, 2 Nov. 1931, Nakhon Ratchasima, Bua Yai (BK); *Put* 4366, 9 Nov. 1931, Nakhon Ratchasima, Lat Bua Khao (BK); *R. Pooma et al*. 2122, 20 Aug. 2001, Buriram, Lam Plaimat (BKF); *R. Pooma et al.* 2519, 24 Aug. 2001, Mukdahan, Dong Luang (BKF); *Sakol* 44, 11 Nov. 1964, Nakhon Nayok, Salika Falls (BK); *Sakol* 3578, 2 Jan. 1976, Khon Kaen, Phu Wiang (BK); *Sakol Suthisorn* 588, 9 Oct. 1965, Chaiyaphum, Tat Ton Water Fall (BK); *Sanoh* 604, 5 Aug 1968, Nakhon Ratchasima, Pak Thong Chai (BKF); *S.P. et al.* 41, 6 Sep. 1969, Loei, Phu Kradung (BKF); *S.P. et al*. 78, Phitsanulok, Thung Salaengluang (BKF); *S. Phusomsaeng* 20, Chiang Mai, Chiangdao (BKF); *TDBS* 5670, Chiang Mai, Doi Suthep (BKF); *T. Shimizu et al*. 12941, 3 Sep. 1967, Loei, Phu Kradung (BKF); *T. Shimizu et al*. T-12942, Loei, Phu Kradung (BKF); *T. Shimizu et al*. T-17902, 6 Oct. 1979, Saraburi, Na Phra Lan (BKF); *T. Shimizu et al*. T-17904, 6 Oct. 1979, Saraburi, Na Phra Lan (BKF); *T. Shimizu et al*. T-18956, 16 Oct. 1979, Chiang Mai, Doi Inthanon (BKF); *T. Shimizu et al*. T-21762, 6 Nov. 1979, Kanchana Buri, Saiyok (BKF); *T. Shimizu et al*. 21844, 6 Nov. 1979, Kanchana Buri, Thong Phaphum (BKF); *T. Smitinand*, 22 Sep. 1985, Sakon Nakhon, Phu Phan (BKF); *Th. Santisuk et al*., 9 Mar. 1994, Phetburi, Kaeng Krachan (BKF); *Th. Wongprasert et al.*, 25 Oct. 1998, Ubon Ratchathani (BKF); *Th. Wongprasert* 9912-9, Chumporn, Khao Thalu (BKF); *T. Smitinand* 12038, 5 Apr. 1975, Lopburi, Lamnarai (BKF); *Vanpruk* 348 (BKF); *Y. Paisooksantivatana* Y1636-85, 2 Oct. 1985, Kalasin, Phu Phan National Park (BK); *Y. Paisooksantivatana* Y2386-89, 22 Jul. 1989, Saraburi, Phraphutthabat (BK)

Chroesthes bracteata (Imlay) B. Hansen
A.F.G. Kerr 14404, 23 Dec. 1929, Trat, Kao Kuap (K)

Chroesthes lanceolata (T. And.) B. Hansen
A.F.G. Kerr 537, 14 Feb. 1909, Chiang Mai, Doi Sutep (K); *A.F.G. Kerr* 1042, 5 Mar. 1910, Chiang Dao

Lepidagathis chiengmaiensis Brem.
TDBS 1754, 1 Mar. 1958, Chiang Rai

Lepidagathis chlorostachya Nees
A.F.G. Kerr 11483, 16 Jan. 1927, Chumphon, Ta Ngaw (BK); *A.F.G. Kerr* 12366, 18 Mar. 1927, Surat Thani, Phanom (BK); *A.F.G. Kerr* 16297, 22 Dec. 1928, Chumphon,

Ta San (BK); *A.F.G. Kerr* 18194, 22 Feb. 1930, Surat Thani, Yan Yao (BK); *C. Niyomdham et al*. 1389, 11 Mar. 1987, Ranong, Rak Warin Falls (BKF); *C. Niyomdham et al*. 2248, Nakhon Si Thammarat, Kung Ching Water Fall (BKF); *Chirayupin* 59, 24 May 1960, Krabi, Nai Chong (BK); *Hiroshike* 33746, 26 Feb. 1983, Chumphon, Hot Spring (BKF); *H. Koyama et al.* 15271, 5 Feb. 1979, Ranong, Punyapan Falls (BKF); *Maxwell* 86-108, 1 Mar. 1986, Surat Thani, Khao Sok (BKF); *Sakol Suthisorn* 2330, 12 Apr. 1967, Ranong, Kra Buri (BK); *Sakol Suthisorn* 5231, 23 Feb. 1982, Krabi, Nai Chong (BK); *Sakol Suthisorn* 5520, 27 Dec. 1982, Surat Thani, Khirirat Nikhom (BK); *TDBS* 11805, Nakhon Si Thammarat, Kung Ching Water Fall (BKF); *T. Shimizu et al*. 27398, Krabi, Ao Luek (BKF); *Umpai*, 23 Feb. 1959, Krabi, Ao Luek (BK); *Umpai* 201, 17 Dec. 1965, Krabi, Nai Chong (BK)

Lepidagathis dissimilis J.B. Imlay
Put 58, Sakeaw, Aranya Prathet, Khok Sung (BKF); *H. Koyama* 30939, 12 Dec. 1982, Mukdahan, Dong Mann (BKF); *Maxwell* 71-704, 5 Nov. 1971, Sukhothai, Muang Kao (BK); *Maxwell* 74-68, 22 Jan. 1974, Sukhothai, Muang Kao (BK); *Sakol Suthisorn* 650, 18 Oct. 1965, Chaiyaphu, Khao Hong (BK)

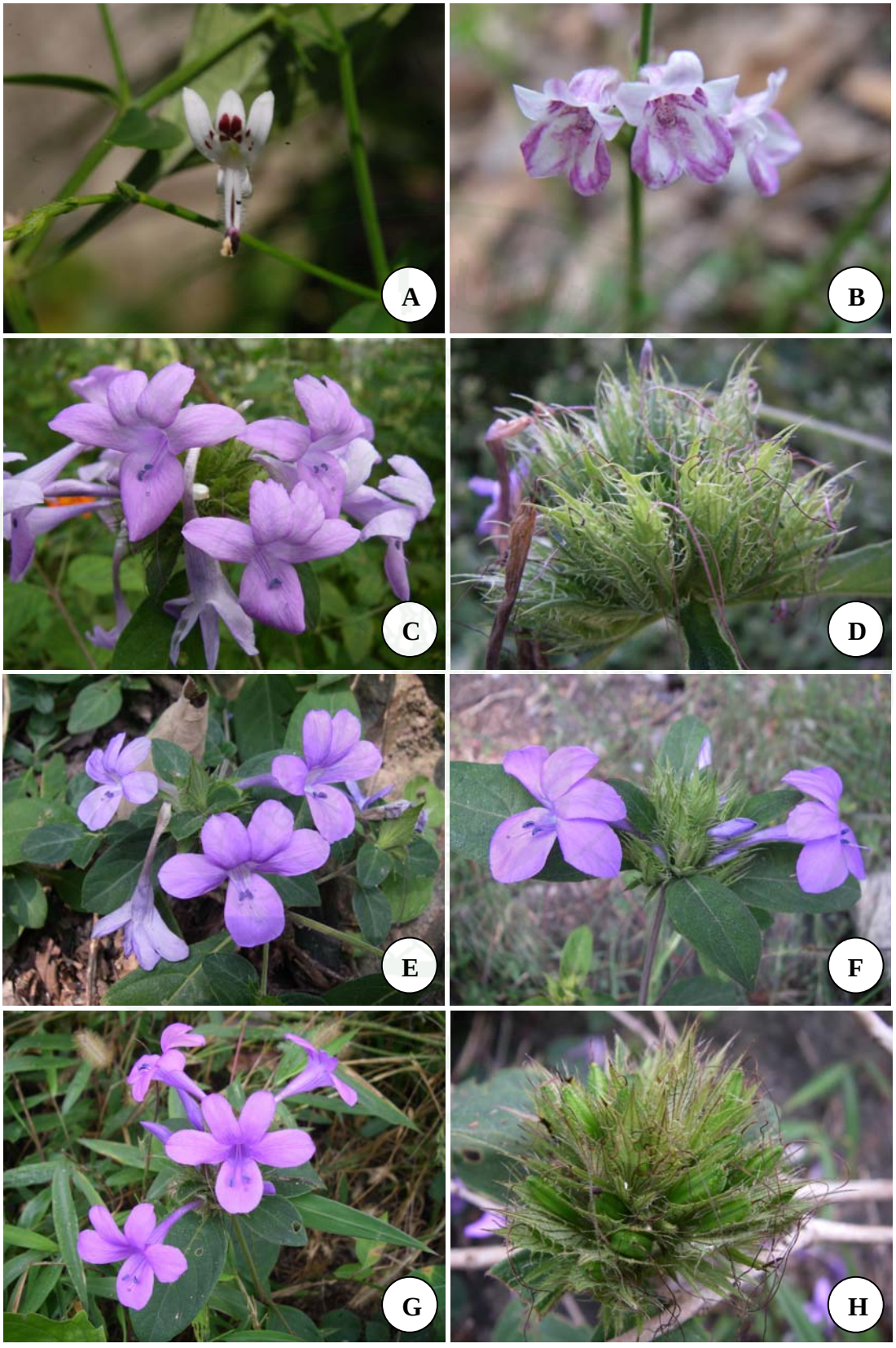
Lepidagathis falcata Nees
A.F.G. Kerr 4600, 18 Nov. 1920, Raheng, Doi Tung Cha (BK); *Bunnak* 547, Dec. 1959, Tak, Bhumibol Dam (BK); *K. Laesen et al.* 3414, 9 Sep. 1974, Mae Hong Son, Tham Pla (BKF); *Sanchai* 604, Dec. 1959, Tak, Bhumibol Dam (BK); *Umpai* 591, 2 Nov. 1980, Sakon Nakhon, Phu Phan (BK); *Umpai* 601, 2 Nov. 1980, Sakon Nakhon, Phu Phan (BK); *Vacharapong* 177, 29 Feb. 1968, Ranong, Kra Buri (BK)

Lepidagathis fasciculata (Retz.) Nees
A. Marcan 1530, 29 Dec. 1923, Pak Chong (BK); *A.F.G. Kerr* 4828, 11 Feb. 1921, Lampang, Pang Pue (BK); *C. F. van Beusekom*, 6 Jan. 1972, Phrae, Huai Rong (BKF); *C. F. van Beusekom* 4832, Phrae, Ridge between Phrae and Uttaradit (BKF); *C. Chermsirivathana* 1029, 14 Nov. 1968, Loei, Phu Luang (BK); *C. Chermsirivathana* 1638, 5 Mar. 1970, Satun, Tarutao Island (BK); *J. Sadakorn* 224, 24 Feb. 1971, Phangnga, Thap Put (BK); *Maxwell* 74-102, 26 Jan. 1974, Sukhothai, Khirimat (BK); *Maxwell* 76-59, 3 Feb. 1976, Uthai Thani, Banrai (BK); *Maxwell* 94-11, Kanchana Buri, Sangkhlaburi (BKF); *Prayad* 1145, 22 Dec. 1967, Chiang Rai, Chiang Kham (BK); *Sakol Sutisorn* 1903, 21 Dec. 1966, Nakhon Nayok, Khao Noi (BK); *Sakol Sutisorn* 3162, 11 Jan. 1975, Nakhon Sawan, Lat Yao (BK); *Sakol Sutisorn* 3581, 23 Oct. 1975, Kalasin, Somdet (BK); *Sakol Sutisorn* 4247, 17 Nov. 1977, Chiang Mai, Nong Hoi (BK); *Sakol Sutisorn* 5233, 23 Feb. 1982, Krabi, Nai Chong (BK); *Y. Paisooksantivatana* Y78A-79, 10 Jan. 1979, Chiang Mai, Suan Song Saen (BK); *Y. Paisooksantivatana* Y559-81, 24 Jan. 1981, Chiang Rai, Muang (BK); *Y. Paisooksantivatana* Y1938-86, 27 Nov. 1986, Phrae, Song (BK)

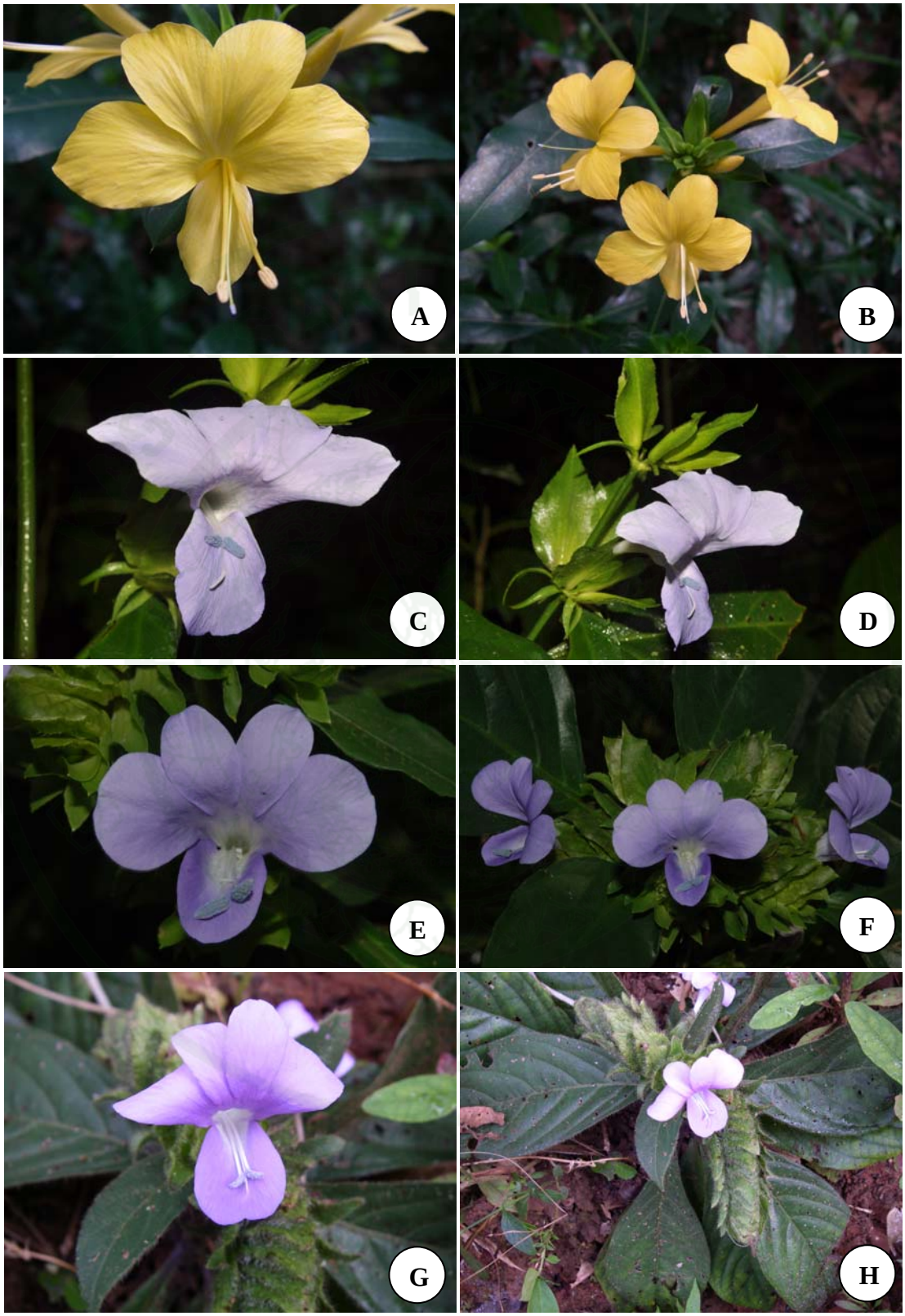
Lepidagathis incurva Ham. ex D. Don.
A. Marcan 1531, 29 Dec. 1923, Pak Chong (BK); *A.F.G. Kerr*, 14 Jan. 1923, Bangkok (BK); *A.F.G. Kerr* 7706, 31 Aug. 1923, Pattani, Bannang Star (BK); *A.F.G. Kerr* 13775, 31 Dec. 1927, Satun, Kuan Po (BK); *C. Chermsirivathana* 297, 8 Mar. 1965, Chiangdao, Tin Tok (BK); *C. F. van Beusekom* 3968, 25 Nov. 1971, Kanchana Buri, Saiyok (BKF); *C. F. van Beusekom* 4412, 18 Dec. 1971, Chaiyaphum, Thung Kramang (BKF); *C. Phengklai* 50496, 15 Nov. 1984, Sakon Nakhon, Phu Phan (BKF); *H. Koyama* 39114, 27 Dec. 1984, Lampang, Doi Khun Tan (BKF); *H.*

Koyama et al. 39649, 27 Nov. 1984, Chiang Mai, Doi Pui (BKF); *J. Sadakorn* 455-4, 17 Jan. 1975, Chiang Mai, Doi Changkian (BK); *Laksanakara* 443, 21 Nov. 1930, Chantabun (BK); *Maxwell* 71-106, 20 Feb. 1971, Bangkok, Khlong San (BK); *Maxwell* 73-709, 8 Dec. 1973, Saraburi, Samlan Forest (BK); *Maxwell* 76-71, 5 Feb. 1976, Uthai Thani, Ban Rai (BK); *M. Tagawa et al*. 1970, 8 Dec. 1965, Loei, Phu Luang (BKF); *N. Fukuoka et al*. 62117, 10 Jan. 1994, Chinag Mai, Doi Suthep-Pui (BKF); *Pradit* 870, 23 Apr. 1964, Phitsanulok, Tung Salaeng Luang (BK); *Pradit & Adisai* 280, 12 Feb. 1963, Khon Kaen, Chumphae (BK); *Put* 2336, 17 Jan. 1929, Prachuap, Kan Kradai (BK); *Put* 2357, 12 Feb. 1929, Tung Song (BK); *Put* 2358, 12 Feb. 1929, Tung Song (BK); *Put* 2542, 24 Dec. 1929, Angtawng (BK); *Put* 4413, 20 Dec. 1931, Doi Chiengdao (BK); *R. Pooma* 993, 19 Jan. 1995, Tak, Krabak Yai National Park (BKF); *Sakol Suthisorn* 1402, 21 Jan. 1970, Chiang Rai, Muang (BK); *Sakol Suthisorn* 1464, 21 Jan. 1970, Chiang Rai, Huai Hin Fon (BK); *Sakol Suthisorn* 1581, 6 Feb. 1970, Chiang Rai, Mae Sai (BK); *Sakol Suthisorn* 4024, 4 Mar. 1977, Uthai Tani, Ban Rai (BK); *TDBS* 11091, 9 Feb. 1964, Tung Salaeng Luang (BK); *Umpai* 152, 16 Dec. 1963, Loei, Phu Kradung (BK); *Umpai* 446, 6 Jan. 1972, Chiang Mai, Hot (BK); *Umpai* 465, 24 Jan. 1973, Lampang, Chae Hom (BK); *Y. Paisooksantivatana* y 549-81, 24 Jan. 1981, Chiang Rai, Muang (BK); *Y. Paisooksantivatana* y 708-81, Feb. 1981, Chiang Mai, Mae Chaem (BK); *Y. Paisooksantivatana* y 1225-83, 4 Feb. 1983, Tak, Mae Tho (BK); *Y. Paisooksantivatana* y 1544-85, 26 Jan. 1985, Tak, Mae Sot (BK); *Y. Paisooksantivatana* y 1964-86, 21 Dec. 1986, Burma, Rangoon (BK)

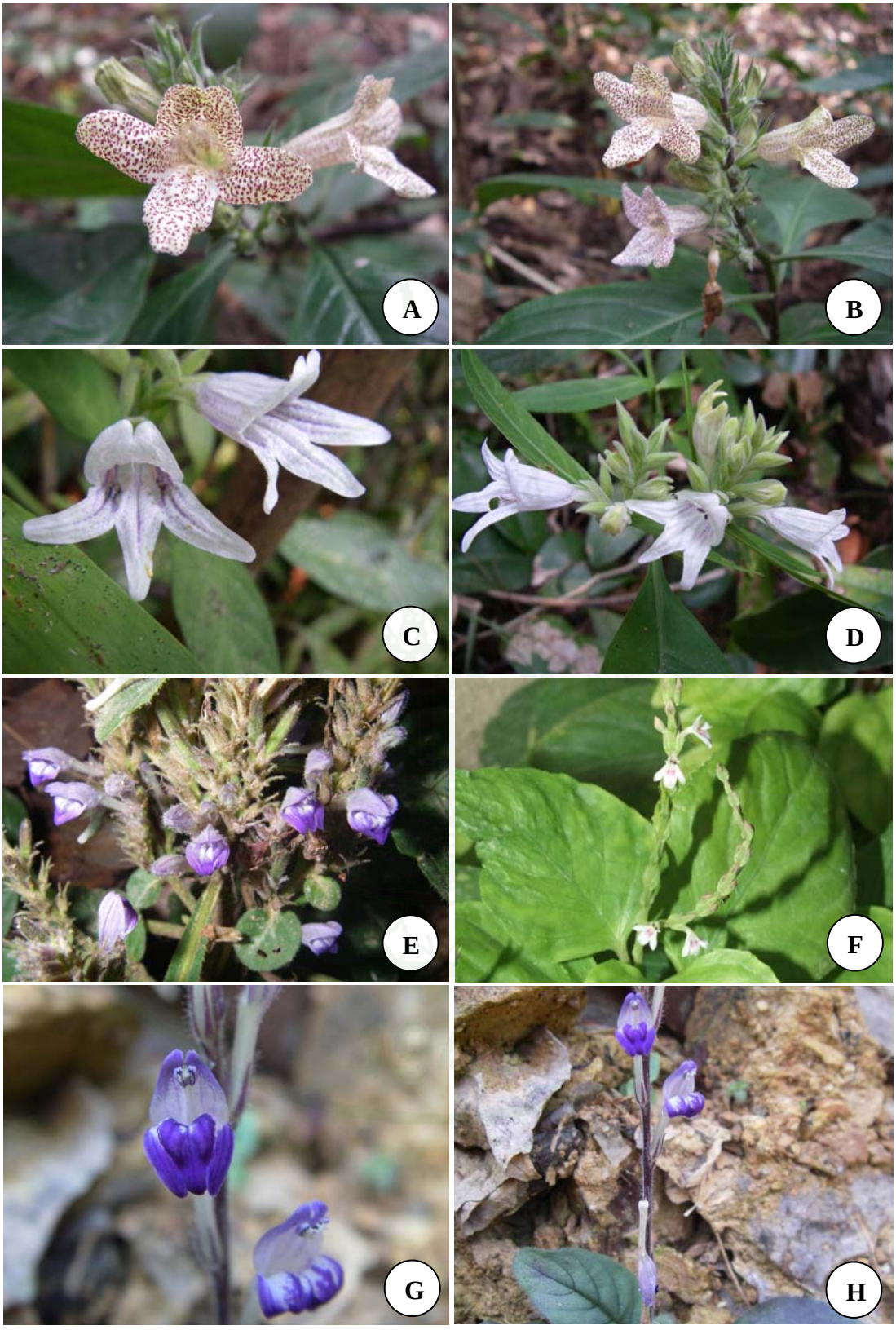
Lepidagathis purpuricaulis Nees
H.B.G. Garrett 1233, 20 Jan. 1994, *Maxwell* 97-122, 3 Feb. 1997, Lampang, Wang Nua (BKF); *Prayad* 624, 22 Dec. 1966, Phisanulok, Thung Salaeng Luang (BK)



Appendix Figure 1 A. *Andrographis paniculata*; B. *A. laxiflora*; C-H. *Barleria cristata*



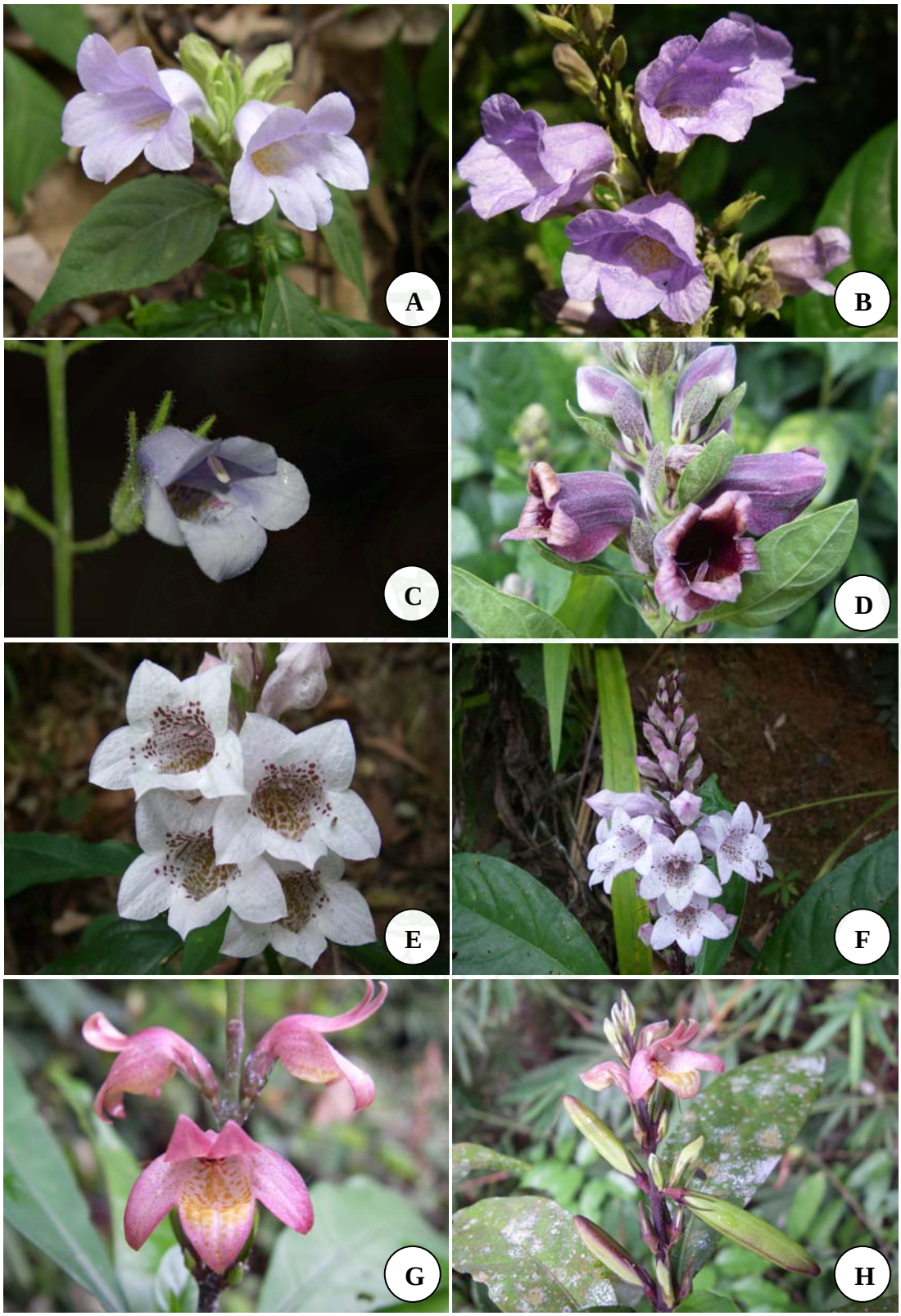
Appendix Figure 2 A-B. *Barleria prionitis*; C-D. *B. siamensis*; E-H. *B. strigosa*



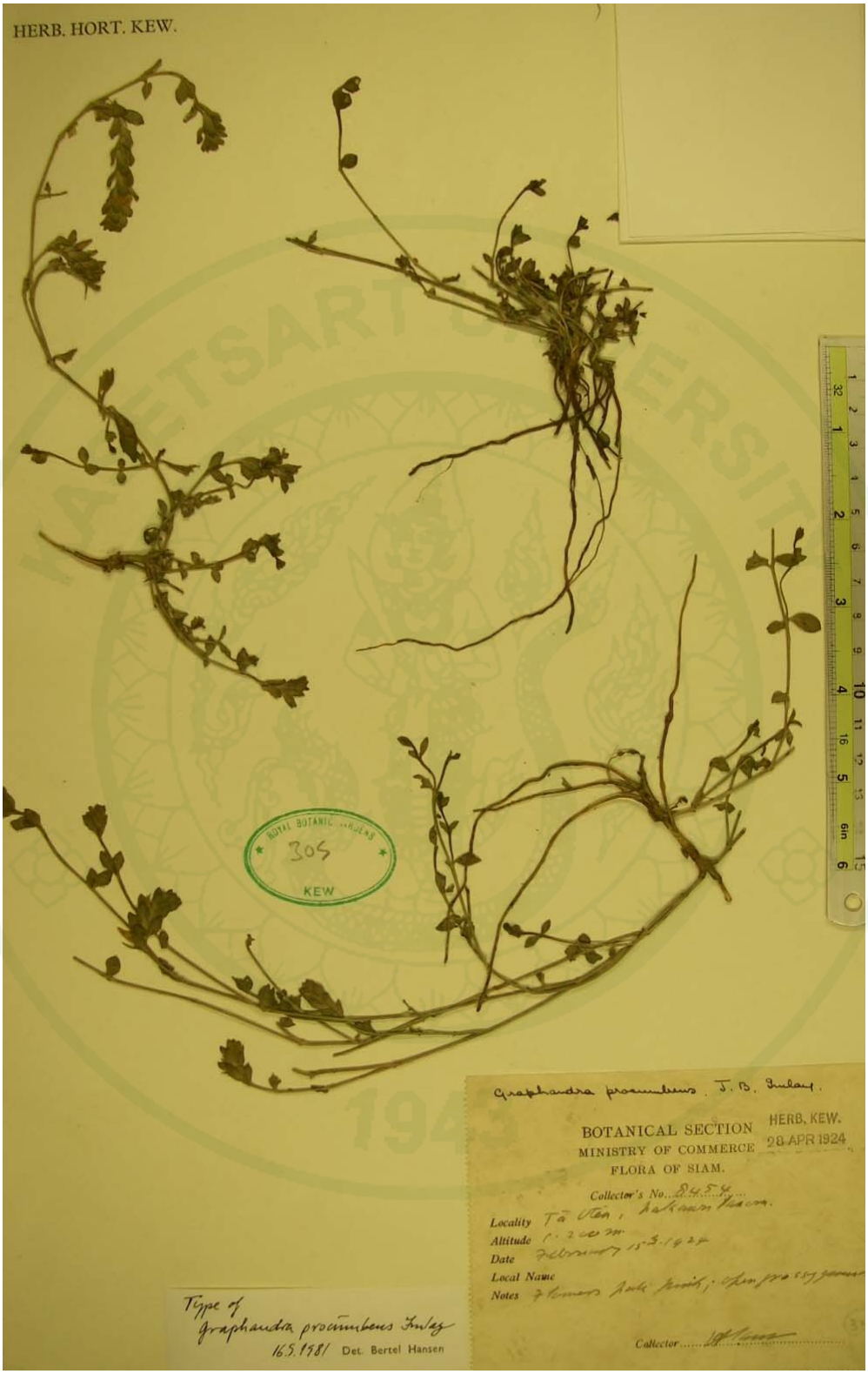
Appendix Figure 3 A-B. *Chroesthes bracteata*; C-D. *C. lanceolata*; E. *Gymnostachyum signatum*; F. *G. trilobum*; G-H. *G. venustum*

Appendix Figure 4 A-B. *Lepidagathis chlorostachya*; C-D. *L. dissimilis*; E-F. *L. falcata*; G-H. *L. incurve*

Appendix Figure 5 A-B. *Lepidagathis incurva*; C-D. *Phlogacanthus asperulus*; E-F. *P. curviflorus*; G-H. *P. paniculatus*



Appendix Figure 6 A-B. *Phlogacanthus pauciflorus*; C. *P. pedunculatus*; D. *P. pulcherrimus*; E-F. *P. rectiflorus*; G-H. *P. vitellinus*



Appendix Figure 7 *Graphandra procumbens*

INDEX

CURRICULUM VITAE

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