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THESIS

TAXONOMY OF THE SUBTRIBE RUELLIINAE (ACANTHACEAE) IN THAILAND AND ITS BIOLOGICAL ACTIVITIES

PANARAT CHAROENCHAI

A Thesis Submitted in Partial Fullfillment of
The Requirements for the Degree of
Doctor of Philosophy (Botany)
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Panarat Charoenchai 2014: Taxonomy of the Subtribe Ruelliinae (Acanthaceae) in Thailand and Its Biological Activities. Doctor of Philosophy (Botany), Major Field: Botany, Department of Botany. Thesis Advisor: Associate Professor Srunya Vajrodaya, Dr.rer.nat. 192 pages.

A taxonomic studies of plants in the subtribe Ruelliinae, tribe Ruellieae, Family Acanthaceae in Thailand, based on classification system of Scotland and Vollesen (2000) and Mallbery (1997) were conducted. The herbarium specimens were examined together with the plant collection from the natural habitats including the ornamental plants. Nine genera, 75 species, 78 taxa are enumerated and listed, i.e. *Clarkesia* (1 species), *Diceratotheca* (1 species), *Dyschoriste* (1 species), *Eranthemum* (6 species), *Hygrophila* (6 species), *Phaulopsis* (1 species), *Ruellia* (8 species), *Sanchezia* (1 species), *Strobilanthes* (49 species, 52 taxa) and *Hemigraphis repanda* (L.) Hallier f. (unplaced species in Strobilanthes). Three species are new transfers from genus *Hemigraphis* i.e. *S. alternata* (Burm. f.) P. Charoenchai, *S. confinis* (Nees) P. Charoenchai, *S. hispidula* (Craib) P. Charoenchai (unpublished). The distinguished characters of this subtribe are cystoliths, left-contorted aestivation, filaments curtain and jaculators in the capsules.

Crude extracts (CH_2Cl_2 and MeOH) of some plants were screened for their antiplasmodial, cytotoxic, antioxidant and radical scavenging activities. These plants i.e. *Eranthemum tetragonum*, *Hygrophila ringens*, *Phaulopsis dorsiflora*, *Ruellia kerrii*, *S. auriculata*, *S. corrugata*, *S. cusia*, *S. dimorphotricha* var. *rex* , *S. karensium*, *S. maxwellii*, *S. pateriformis*, and *S. brandisii*. CH_2Cl_2 extracts of *S. corrugata*, *S. cusia*, *S. maxwellii*, *S. pateriformis* and *S. brandisii* showed antiplasmodial activity with the IC_{50} values of 10-100 μg/mL. CH_2Cl_2 extracts of plants i.e. *H. ringens*, *P. dorsiflora*, *S. corrugata*, and *S. maxwellii* showed cytotoxic activity with the IC_{50} values of 3.5-46.0 μg/mL. MeOH extracts (at 100 μg/mL) of *R. kerrii* and *S. auriculata* could effectively scavenge DPPH free radicals (82-83 % inhibition) and superoxide anion radicals (79 and 88 % inhibition). In the ORAC antioxidant assay, MeOH extracts of *R. kerrii*, and *S. auriculata* exhibited the activity with the ORAC units of 3.1-3.9.

Key words

Ruelliinae; Acanthaceae; Antiplasmodial activity; Cytotoxic activity; Radical scavenging; Antioxidant activity; Cancer chemoprevention

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Student's signature Thesis Advisor's signature

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Panarat Charoenchai
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LIST OF HERBARIAL ABBREVIATIONS

BKF = The forest Herbium, Department of National Park, Wildlife and Plant Conservation, Bangkok, Thailand

BK = The Bangkok Herbarium, Department of Agriculture, Bangkok, Thailand

BM = The Herbarium of The Natural History Museum, London, UK

CMU = The Herbarium of Biology Departmanet, faculty of science, Chiang Mai University, Chiang Mai, Thailand

K = Kew Herbarium, Royal Botanic Gardens, London, UK

PSU = The Herbarium of Prince of Songkhla University

SLR = Suan Luang Rama 9 Herbarium, Bangkok, Thailand

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TAXONOMY OF THE SUBTRIBE RUELLIINAE (ACANTHACEAE) IN THAILAND AND ITS BIOLOGICAL ACTIVITIES

INTRODUCTION

Thailand is located at latitude 5°-21'N and longitude 97°-106'E. Total area is about 513,115 km^2 and the Floristic region is in southeastern Asia (Frodin, 2001). In fact, Thailand was highly diverse of biological resources but rate of land use have acceleration due to the progressive disruption of ecosystems by natural disasters and human activities. Several wild species of plants are endangered or extinct. For the flora of Thailand, approximate 60% has already been identified. Hence, there are still many unkhown taxa, families to be revised, and to be studied. Several species of Acanthaceae are popular used as traditional medicine in Thailand. Many species are still unknown for their usage.

Acanthaceae is one of the large pantropical family of about 229 genera and 3,450 species (Mabberley, 1987). Present in herbs or shrubs, including twining forms. Most are tropical herbs, shrubs, or twining vines, some are spiny. Only a few species are distributed in temperate regions, the four main centres of distribution are Indo-Malaya, Africa, Brazil and Central America (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 of 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)

The subtribe Ruelliinae *sensu* Scotland and Vollesen (2000), tribe Ruellieae, family Acanthaceae consisted of 48 genera, ca. 977 species (Olmstead, 2005). Presently, they are terrestrial (annual and perennial) herb, shrub with gregarious and pleitacial or monocarpic (taking about many years to mature, flower, and then die), some are submerged aquatic herbs (*Hygrophila* R. Br.) and distribute in pantropical, centered in Indomalasia, Africa, Brazil and central America (Watson and Dallwitz, 1992). The distinguished characters are cystoliths, left-contort aestivation, filament

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curtain and jaculators (Scotland and Vollesen, 2000). In Thailand, the common and well known species are *Ruellia tuberosa* L. (Thai name: Toi Ting), native plant in the west of India, introduced to Thailand and until now is a common weed throughout the country. Especially in dry area and slightly shade places. *Strobilanthes cusia* (Nees) Kuntze (Thai name: Kham, Hom) has been used as an indigo blue dye and a traditional Thai medicine used in the treatment of fever, headache, sore throat, and bronchitis.

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OBJECTIVES

1. To study the taxonomy of the subtribe Ruelliinae *sensu* Scotland and Vollesen (2000), tribe Ruellieae, family Acanthaceae in Thailand.

2. To construct the Keys, descriptions and illustrations of the subtribe Ruelliinae *sensu* Scotland and Vollesen (2000), tribe Ruellieae, family Acanthaceae in Thailand.

3. To study the bioactivity of the extracts from some species in the family Acanthaceae.

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LITERATURE REVIEW

The studies on the family Acanthaceae are carried out through the details of corolla aestivation, palynological and phylogenetical data for classification of this family. Scotland andVollesen (2000) classified the family Acanthaceae into 3 subfamilies, i.e. Nelsonoideae, Thunbergioideae and Acanthoideae. The subfamily Acanthoideae was classified into 2 tribes, i.e. Acantheae and Ruellieae. The tribe Ruellieae was classifiedinto 4 subtribes, i.e. Ruelliinae (48 genera), Andrographinae (8 genera), Justiciinae (103 genera) and Barleriinae (9 genera). Hansen (1985) reported that there were 40 genera, 230 species in Thailand. Distinctive featured of the family Acanthaceae include their explosive capsules armed with jaculators (hook-like structures on the inner wall of the dehiscent capsule, modified to propel the seeds outward), bilaterally symmetrical flowers, and primarily opposite leaves. The stems and leaves also typically contain minute crystalline structure called cystoliths, whose shape, size and arrangement are sometimes taxonomically useful. (Staples and Herbst, 2005)

1. Classification of the subtribe Ruelliinae, tribe Ruellieae (Acanthaceae)

The family Acanthaceae was first established by Lindau (1895) in Die Natuerlichen Pflanzenfamilien vol. 4 (3b). The type species is *Acanthus*. There are about 229 genera and 3,450 species (Mabberley, 1997). “Ruelliinae” is derive from the French-botanist’s name, Jean Ruel (Joannes Ruellius, Jean de la Ruelle de Ruel), 1474-1537.

Rendle (1971) proposed the Acanthaceae lies within class Dicotyledons; subclass Sympetalae; superorder Tetracyclicae; order Tubiforae and suborder Solanieae.

Mabberley (1987) proposed the Acanthaceae lies within class Dicotyledons; subclass Asteridae and order Scrophulariales.

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Simpson (2006) followed APG II (2003), and proposed the Acanthaceae lies within the Agiosperms; Eudicots; Asterids; Euasterid I and Lamiales.

Bremekamp (1948) classified the tribe Ruellieae, family Acanthaceae into 6 subtribes, i.e. Strobilanthinae, Petalidiinae, Blechinae, Hygrophilinae, Ruelliinae and Barleriinae. And made a key to the genera of the Ruelliinae, which composed the genera as follows: *Ruellia* (included *Arrhostoxylum* Nees, *Stephanophysum* Pohl, *Dipteracanthus* Nees and *Nothoruellia* Brem., *Pararuellia* Brem., *Leptosiphonium* Mull., and *Eranthemum* L.

Bremekamp (1965) classified the family Acanthaceae into 2 subfamilies as: subfamily 1. Acanthoideae: 5 tribes i.e. Haselhoffideae, Rhombochlamydeae, Stenandriopsidea, Aphalandreae and Acantheae; Subfamily 2. Ruellioideae: 2 tribes i.e. Trichanthereae, Whitfieldieae, Ruellieae (6 subtribes i.e. Blechinae, Ruelliinae, Barleriinae, Strobilanthidinae, Petalidiinae and Hygrophylinae), Lepidagathideae (3 subtribes i.e. Lepidagathinae, Chroesthidinae and Borneacanthinae), Andrographideae, Justicieae (3 subtribes i.e. Odonteminae, Rhytiglossininae and Justiciinae).

Benoist (1935) classified the family Acanthaceae into 6 tribes, i.e. Thunbergiées, Nelsoniées, Ruelliées, Barleriées, Acanthées and Justiciées.

Hansen (1985) has proposed a list of the genera in Acanthaceae which distribute in Thailand as: Subfamily I. Thunbergioideae: *Thunbergia* Retz (6); Subfamily II. Nelsonioideae: *Nelsonia* R. Br. (1), *Ophiorrhiziphyllon* Kurz (1) and *Staurogyne* Wall. (c. 25); Subfamily III. Acanthoideae: *Acanthus* L. (3), *Blepharis* Juss.(1), *Crossandra* Salisb.(1); Subfamily IV. Ruellioideae, Tribe A. Ruellieae: *Dyschoriste* Nees (1), *Echinacanthus* Nees (1), *Eranthemum* L. (6), *Hygrophila* R. Br. (6) (incl. *Cardanthera* Voigt, *Hemiadelphis* Nees, *Nomaphila* Bl. and *Synnema* Benth.), *Phaulopsis* Willd. (1), *Ruellia* Willd. (1) and *Strobilanthes* Bl.(c. 55), Tribe B. Lepidagathideae: *Chroesthes* Benoist (2), *Lepidagathis* Willd. (66) and *Neuracanthus* Nees (1), Tribe C. Andrographideae: *Andrographis* Nees (2), *Gymnostachyum* (7) *Graphandra* Imlay (1) and *Phlogacanthus* Nees, Tribe D.

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Justicieae: Subtribe a. Barleriinae: *Asyatasia* Blume (2), *Asystasiella* Lindau(1), *Barleria* L. (5), *Clinacanthus* Nees (1), *Codonacanthus* Nees (1), *Cosmianthemum* Bremek. (1), *Graptophyllum* Nees (1), *Pseuderanthemum* Radlk. (8), *Thysanostigma* Imlay (1); Subtribe b. Isoglossinae: *Dicliptera* Juss. (4), *Hypoestes* R. Br. (2), *Isoglossa* Orst. (2), *Leptostachya* Nees (1), *Marcania* Imlay (1), *Peristrophe* Nees (4), *Ptyssiglosttis* T. Anderson (2); Subtribe c. Justiciinae: *Justicia* L. (c.40), *Rhinacanthus* Nees (1), *Rugia* Nees (10)**.**

Olmstead (2005) has recognized taxa within the Lamiales, together with information on distribution and species richness. There are 48 genera in subtribe Ruelliinae, Family Acanthaceae as: *Acanthopale* C. B. Clarke (150) OW trop., *Aechmanthera* Nees (3) Himal., *Apassalus* Kobuski (3) SE US, W. I., *Beniocanthus* Heine & A. Raynal (2) Madag., *Blechum* P. Brown (6) trop. Amer., *Bravaisia* DC. (3) trop. Amer., *Brillantaisia* P. Beauv. (9) trop. Africa, Madag., *Brunoniella* Bremek. (6) New Guinea, Australia, Calacanthus T. Anderson ex Benth. (1) Indomal., *Clarkeasia* J. R. I. Wood, *Dischistocalyx* T. Anderson ex Benth. (20) Africa, Duosperma Dayton (12) trop. & S. Africa, *Dyschoriste* Nees (65) warm & trop. NW & OW, *Echinacanthus* Nees (4) Himal., China, *Epiclastopelma* Lindau (2) trop. Africa, *Eranthemum* L. (30) trop. Asia, *Eremomastax* Lindau, *Eusiphon* Benoist (3) Madag., *Hemigraphis* Nees (90) Asia to New Caledonia, *Heteradelphia* Lindau (1) W. Africa, *Hygrophila* R. Br. (25) trop. OW & NW, *Ionacanthus* Beniost (1) Madag., *Kosmosiphon* Lindau (1) trop. W. Africa, *Leptosiphonium* F. Muell. (10) *Papauasia*, *Louteridium* S. Watson (6) Mex. & C. Amer., *Lychniothyrsus* Lindau (5) Brazil, *Mellera* S. Moore (5) warm Africa, Mimulopsis Schweinf. (3) trop. Africa, Madag., *Pararuellia* Bremek. (5) Malaysia, *Petalidium* Nees (35) trop. & S. Africa, Himal., India, *Phaulopsis* Willd. (20) Afra. Mascarenes, India, *Physacanthus* Benth. (5) trop. Africa, *Polylychnis* Bremek. (2) NE S. Amer., *Pseudoruellia* Benoist (1) Madag., *Ruellia* L. (150) temp. & warm to trop. Amer., *Ruelliospis* C.B. Clarke (3) trop. & S. Africa, *Sanchezia* Ruiz & Pav.(20) trop. Amer., *Satanocrater* Schweinf. (4) trop. Africa, *Sautiera* Decne. (1) Timor, *Spirostigma* Nees (1) Brazil, *Stenosiphonium* Nees (3) India, Sri Lanka, *Stenothyrsus* C. B. Clarke (1) Malaya, *Strobilanthes* Blume (250) trop. Asia, *Strobilanthopsis* S. Moore (5) trop. Africa, *Suessenguthia* Merm. (1)

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Bolivia, *Trichanthera* Kunth (2) N. S. Amer., *Trichosanchezia* Mildbr. (1) trop. Peru, *Zygoruellia* Baill. (1) Madag.

1. Morphological Characters of the subtribe Ruelliinae, tribe Ruellieae (Acanthaceae)

2.1 Habit

Usually, they are (annual or perennial) herbs, undershrubs or shrubs. Tree is rarely found Somes are aquatic herbs (*hygrophila*). *Ruellia prostrata*, *Hemigraphis* spp., etc., are typical examples of herbs. Several species are undershrubs, e.g., *Ruellia tuberosa*, *Strobilanthes coloratus*, *Eranthemum pulchellum*, etc. Some good examples of shrubs are *Strobilanthes* with gregarious and pleitacial or monocarpic (taking about many years to mature, flower and then die). (Pandey, 2005)

2.2 Leaves

The leaves are simple, whorled or opposite and decussate arrangement, entire and glabrous, without stipule. The petioles are short. The leaf texture is thin with the reticulated veins (Cramer and Wood, 1998). The characteristic anatomical feature of this family is the presence of cystoliths (calcium carbonate crystals) in the epidermal cells of leaves and stems. Sometimes double cystoliths are found. (Pandey, 2005)

2.3 Inflorescences

The inflorescence is cymose type, discharisal cyme passes to monochasial cyme on in the higher branching. Sometimes the flowers are found to be arranged in the short axillary clusters. Spikes and racemes are also frequently found. Bracts and bracteoles generally well developed and often brightly coloured. The flowers of *Strobilanthes discolor* are found to be arranged in panicled cymose heads whereas in *Strobilanthes anisophyllous*, these are arranged in cymose head. (Backer, 1965)

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2.4 Flowers

The structure of flower is very uniform. The flowers are bracteate; bracteolate, hermaphrodite, complete, zygomorphic (irregular) and hypogynous. Usually, the flowers are tetramerous or pentamerous, but generally there is a reduction to 4 or 2 in the androecium, and there are two carpels in the gynoecium. (Bremekamp, 1948a, 1948b; Cramer and Wood, 1998)

2.5 Calyx

The calyx is usually gamosepalous with deeply 4-5 lobed or sometimes is highly reduced with more numerous minute teeth. (Bremekamp, 1948a, 1948b; Cramer and Wood, 1998)

2.6 Corolla

The corolla is sympetalous, usually 5-merous, mostly zygomorphic, and commonly 2 lipped or bilabiate, e.g., in *Ruellia* in such cases the upper lip of the corolla is erect and bifid at the apex and the lower lip is horizontal and three-lobed forming the landing-platform for the insects. Usually the corolla possesses a large or short slender corolla tube which passes above into an equally five lobed limb. The inner side of the lip of the corolla possesses dense hairs. These hairs often extend to the mouth of the corolla. The aestivation is contorted. (Bremekamp, 1948a, 1948b; Cramer and Wood, 1998)

2.7 Androecium

The androecium usually consists of 4 didynamous stamens or only 2 stamens (rarely 5) adnate to the corolla tube or epigynous zone, alternate with the lobes. In certain cases only two stamens are found. In the cases where there are only four stamens, the fifth posterior stamen reduces to a staminode or disappears completely. The anthers may be two or one celled. In case where on celled anthers are

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found, a rudiment of the second cell may be seen, whereas, in case of two-celled anthers, the cells are equal and more or less separated by a connective. Sometimes the lower cell of the anther becomes spurred. The shape and size of pollen grains are quite different from genus to genus. (Bremekamp, 1948a, 1948b; Cramer and Wood, 1998)

2.8 Gynoecium

The gynoecium consists of a single compound pistil of 2 carpels, syncarpous. The superior ovary, bilocular, two or more ovules are found in each locule, axile placentation. The style is long and slender, projects out from the mounth of the corolla tube. There are two small stigmas, and the posterior stigma is usually reduced. An annular nectary disk is usually found around the base of the ovary. (Bremekamp, 1948; Backer, 1965; Cramer and Wood, 1998)

2.9 Fruits

The fruit is commonly loculicidal capsule. (Cramer and Wood, 1998)

2.10 Seeds

The seeds are rounded and exalbuminous in the *Ruellia*, the funicle of the seeds forms a hook-like projection, known as jaculator, in which seed rests. These hook-like jaculators make the fruits burst and seeds become dispersed in different directions. (Cramer, 1998)

3. Leaf anatomy

Abaxial epidermis is papillose, or not. 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 is rarely present, or absent. The lamina is dorsiventral, or rarely isobilateral, without secretory cavities.

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Most of the Cystoliths are very commonly presented by showing as streaks in the lamina (Fahn, 1990). Thery are three types, 1. Double cystolith, found in *Barleria* L., i.e. *Barleria prionitis* L.; *Barleriola* Oerst., and *Crabbea* Harv., 2. Solitary, round cystolith, found in *Asystasia* Blume, i.e. *Asystasia scandens* Hook. And *Codonacanthus* Nees., 3. Solitary elongated cystolith found in *Graptophyllum* Nees (Metcalfe and Chalk, 1957). Calcium carbonate (lime) is found in the cells of some plants as an encrustation on the walls or in the form of an unusual deposit called a cystolith. Cystoliths are typically located in enlarged surface cells of leaves called lithocysts, where the calsium carbonate is deposited over a cellulosic extension that hangs from the wall. Cystoliths are found in several unrelated dicotyledonous families. Spherical, bacilliform, and fusiform, (curved or straight) types of cystoliths may be systematically useful at various taxonomic levels, as evidenced by the general correspondence between cystolith shape and tribal circumscription. Different species within a genus may have cystoliths with markings of distinctive shape. (Beck, 2005; Dickson, 2000)

Stace (1994) reported that among the many taxonomically important features of stomata, the arrangement of the surrounding epidermal cells (termed subsidiary cells if they are distinct from the normal epidermal cells) is the most valuable. The occurrence of these types is often valuable at the higher taxonomic levels. Thus in the Acanthaceae the stomata are diacytic, whereas in the closely related Scrophulariaceae. The stomata are anomocytic.

4. Palynological study of Acanthaceae

Erdtman (1952) reported that detailed pioneer investigations of acanthaceous pollen grains were made by Fritzsche in 1837 and Mohl in 1834; cf. also Bischoff in 1833. About half a century later Radlkofer described a number of distinct pollen types (“Dauben-, Rahmen-, Rippen-, Spangen- and Wabenpollen,” etc.) Since the publication of Lindau’s profusely illustrated papers, pollen study has been considered ± a coditio sine qua non in taxonomical work within Acanthaceae. Pollen is distinctly eurypalynous family. Pollen grains isopolar, radiosymetric, or less frequently bilateral,

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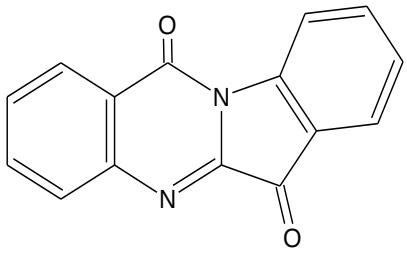
di-polyaperturate (3-8-colpate, 3-colpoidorate, 3-5-colporate, 2-4-porate, forate, zon- or spiraperturate etc.; colporat grains sometime provided with pseudocolpi), peroblate-perprolate [peroblate in *Meyenia hawtayneana*, perprolate e.g. in *Crossandra undulaefolia* (87x42 µm) and *Pachystachys* (*Jacobinia*) *coccinea* (71x32 µm). The Longest axis is 20 µm in *Staurogyne diantheroides* (Brazil; Malme 1815), up to 115 µm, according to Lindau (1905) in *Ruellia glandulosonotata*. And *Hygrophila spinosa*: 4-colporate (4 colpi and 12 pseudocolpi; one 6-colporate grain noted), spheroidal (70 x 66 µm). The sexine is thinner than the nexine, retuculate. Ora circular or slightly lolongate.

Scotland (1992) studied the pollen morphology of contortae (Acanthaceae) and presented a parsimony analysis of pollen characters for 36 genera. The pollen have descriptions in group such as; Trichantereae, Louteridieae, Hygrophileae, Petalideae, Ruellieae and Strobilantheae. *Strobilanthes* Blume is monophyletic and few autapomorphic pollen morphologies within it, are uniquely derived within the genus, *Gantelbua, Hemigraphis, Aechmanthera* and *Stenosiphonium* are sister taxa to *Strobilanthes*.

5. Phytochemistry of Acanthaceae

Trytanthrine or Couroupitine A, C_{15} H_8 N_2 O_2, Mol. Wt 248.24 found in the leaves of *Strobilanthes cusia* (Acanthaceae), in *Polygonum tinctorum* (Polygonaceae), and in *Couroupia guaianensis* (Lecythidaceae). Also, it has been isolated from the yeast *Candida albicans*, grown in the presence of tryptophan. *Strobilanthes cusia* is used as a folk remedy for athlete's foot in Japan. (Harborne *et al.*, 1999)



Trytanthrine

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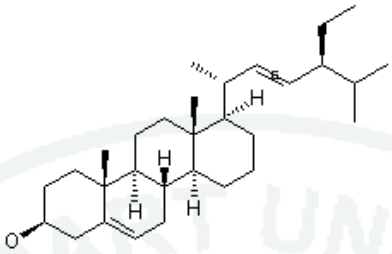
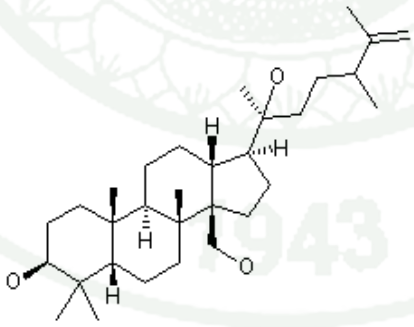
Mukherjee *et al.* (1991) reported that a stigmasterol has been isolated from *Hemigraphis hirta* T. Anderson



Li *et al.* (1993) isolated seven compounds from the whole plant of *Strobilanthes cusia* (Nees) O. Ktze. Three of them are triterpenes, two are indole alkaloids, two are quinazolinone alkaloids. And their structures were established as lupeol, betulin, lupenone, indigo, indirubin, 4(3H) –quinazolinone and 2, 4 (1H, 3H) –quinazolinedione were found from natural plant. The results of the pharmacological tests demonstrate that indirubin has anticancer activity and 4(3H) –quinazolinone has hypotensive action.

Singh *et al*. (2002) isolated a new triterpenoid from the aerial parts of *Ruellia tuberosa* L., 21- methyldammar-22-en-3 β, 18, 27-triol ($C_{31}H_{54}O_3$)



Tanaka *et al*. (2004) found a new lignan glycoside and two new phenylethanoid glycosides together with five known compounds as chemical constituents of *Strobilanthes cusia* root. Some samples were examined for anti-herpes simplex virus type-1 (HSV-1) activity. Among the tested samples, lupeol showed anti-HSV-1 activity (EC (50): 11.7 µm) and showed 100% inhibition of virus plaque formation at 58.7 µm.

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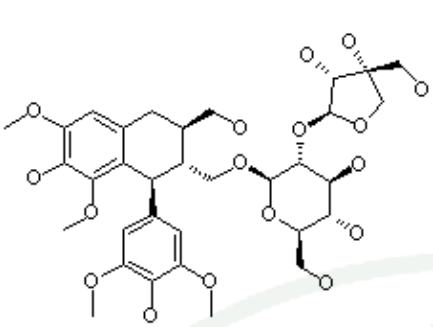
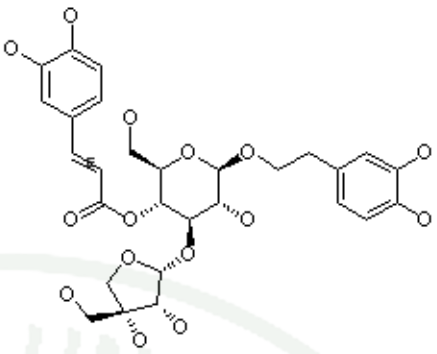


(+)-lyoniresinol 3α-O-β-D-apiofuranosyl-(1-2)-β-D-glucopyranoside



[2-(3,4-dihydroxyphenylethyl)]-3-O-α-D-apiofuranosyl-(1-3)-(4-O-caffeoyl)-β-D-glucopyranoside

6. Pollination

The pollinations of the family Acanthaceae are broadly reported by bugs.The pollination takes place through the agency of insects. (Pandry, 2005)

7. Seed dispersion

There are many genera such as *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)

8. Ecology and distribution

It was reported that most of subtribe Ruelliinae, Family Acanthaceae are grown in tropical and subtropical zones especially in moist area. (Pandey, 2005)

9. The previous studies of the subtribe Ruelliinae, tribe Ruellieae (Acanthaceae) in Thailand, Southeast Asia, South Asia and other regions

Schmidt (1902) studied and enumerated the vegetation in the gulf of Siam, Flora of Koh Chang and the Acanthaceae were reported 13 taxa: *Ebermaiera*

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subcapitata C.B. Clarke, *Hygrophila quadrivalvis* Nees, *Strobilanthes rufescens* T. Anderson, *S. parvibracteatus* C.B. Clarke, *Acanthus ilicifoilius* L. var. *ilicifolius*, *A. ilicifolius* L. var. *integrifolia* T. Anderson, *Eranthemum zollingerianum* Nees, *E. album* Nees, *E. pumilio* C. B. Clarke, *Justicia gendarussa* L., *Adhatoda vasica* Nees, *Rugia parviflora* Nees and *Hypoestes* cf. *schmidtii* C.B. Clarke.

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

Benoist (1936) enumerated the family Acanthaceae for Indochinese regions through the morphological studies with key to speciesemphasized on calyx, corolla, stamen and anther characters. It was reported that the tribe Ruelliees consisted of 8 genera i.e. *Cardanthera, Hygrophila, Ruellia, Hemigraphis, Dyschoriste, Eranthemum, Strobilanthes, Phaylopsis* and *Chroesthes*. *Cardanthera* Buch.-Ham. ex Benth.(= *Hygrophila* R.Br.) had 1 species, *C. avana* Benth. *Hygrophila* R. Br. had six species, i.e. *H. polyserma* T. Anderson, *H. angustifolia* R. Br., *H. phlomoides* Nees, *H. incana* Nees, *H. stricta* Lindau and *H. episcopalis* R. Benoist. *Ruellia* L. had nine species, i.e. *R. macrosiphon* Kurz, *R. bella* Craib, *R. vincta* R. Ben, *R. kerrii* Craib, *R. patula* Jacq, *R. repens* L., *R. flagelliformis* Roxb, *R. poilanei* R. Ben. and *R. tuberosa* L. *Hemigraphis* Nees had ten species, i.e. *H. colorata* Hallier f., *H. griffithiana* T. Anderson, *H. modesta* R. Ben., *H. turneraefolia* R. Ben., *H. confinis* T. Anderson var. *hirsuta* C.B. Clake, *H. quadrifaria* T. Anderson, *H. glaucescens* C.B. Clarke, *H. schomburgkii* Craib, *H. chinensis* T. Anderson and *H. hispidula* Craib.

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Dyschoriste Nees had two species, i.e. *D. erecta* O. Kuntze and *D. principis* B. Ben. *Eranthemum* L. had three species, i.e. *E. nervosum* R. Br. ex Roem., *E. tetragonum* Wall. and *E. ciliatum* R. Ben nov. comb., *Strobilanthes* Blume had thirty-eight species, i.e. *S. subflaccidus* Kurz, *S. apricus* T. Anderson, *S. hypomallus* R. Ben., *S. pentstemonoides* T. Anderson var. *anfractuosus* R. Ben., *S. pentstemonoides* T. Anderson var. *rex* R. Ben., *S. acrocephalus* T. Anderson, *S. imbricatus* Nees, *S. multangulus* R. Ben., *S. obesus* R. Ben., *S. microcephalus* R. Ben., *S. pierrei* R. Ben., *S. gigantodes* Lindau, *S. poilanei* R. Ben., *S. jugorum* R. Ben., *S. consors* C.B. Clarke, *S. evrardi* R. Ben., *S. radicans* T. Anderson, *S. lilacinus* C.B. Clarke, *S. auriculatus* Nees, *S. brunnescens* R. Ben., *S. cystolithiger* Lindau, *S. mucronato-productus* Lindau, *S. peteloti* R. Ben., *S. polystachyus* R. Ben., *S. tonkinensis* Lindau var. *sarmentosus* R. Ben., *S. sulfurous* R. Ben., *S. comosus* R. Ben., *S. flaccidifolius* Nees, *S.pateriformis* Lindau, *S. patulus* R. Benoist, *S. dalziellii* R. Ben. n. comb. var. *inaequalis* R. Ben., *S. sarmentosus* R. Ben., *S. anamiticus* O. Ktze, *S. bantonensis* Lindau, *S. erectus* C.B. Clarke, *S.hossei* C.B. Clarke, *S. saltiensis* S. Moore, *S. squalens* S. Moore *and S. xanthostictus* C.B. Clarke. *Phaylopsis* Willd. (=*Phaulopsis* Willd.) had 1 species, *P. parviflora* Willd.

Imlay (1939) enumerated the family Acanthaceae to the Flora of Siam. It was reported that the tribe Ruellieae consisted of 6 genera such as *Synnema, Hygrophila, Ruellia, Echinacanthus, Eranthemum* and *Strobilanthes*. There were recorded 31 taxa; i.e. *Synnemabiplicatum* (Nees) J. B. Imlay, *Hygrophila saliciflolia* (Vahl) Nees var. *quadrivalvis* (Buch.-Ham.) J.B. Imlay, *H. stricta* (Vahl) Lindau var. *siamensis* (C.B. Clarke) J.B. Imlay, *H. intermedia* J.B. Imlay, *Ruellia malasica* (C.B. Clarke) J.B. Imlay, *R. subulata* J.B. Imlay, *R. dissimilis* J.B. Imlay, *R. hirtella* J.B. Imlay, *R. siamensis* J.B. Imlay, *Echinacanthus siamensis* J.B. Imlay, *Eranthemum obovatum* J.B. Imlay, *Strobilanthes cusia* (Nees) J.B. Imlay, *S. strobilatus* J.B. Imlay, *S. apricus* (Hance) T. Anderson, *S. gramineus* J.B. Imlay, *S. serrantus* J.B. Imlay, *S.albo-viridis* J.B. Imlay, *S. suborbicularis* J.B. Imlay, *S. maingayi* C.B. Clarke var. *glaber* J.B. Imlay, *S. pectinatus* T. Anderson var. *acuminatus* J.B. Imlay, *S. pectinatus* var. *glandulosus* J.B. Imlay, *S. pectinatus* var. *punctatus* J.B. Imlay, *S. evrardii* R. Ben. var. *parviflorus* J.B. Imlay, *S. incisus* J.B. Imlay, *S. turgidinodis* J.B. Imlay,

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S. argenteus J.B. Imlay, *S. articulatus* J.B. Imlay, *S. latibracteatus* J.B. Imlay, *S. corrugatus* J.B. Imlay, *S.viscidus* J.B. Imlay and *S. bombycinus* J.B. Imlay.

Bremekamp (1948) studied in the family Acanthaceae in Java Islands and proposed the tribe Ruellieae lies within 4 subtribes; i.e. Ruelliinae, Strobilanthinae, Hygrophilinae, and Barleriinae. The subtribe Ruelliinae *sensu* Bremekamp consisted of *Ruellia* L., *Arrhostoxylum* Nees, *Stephanophysum* Pohl, *Dipteracanthus* Nees, *Pararuellia* Brem., and *Eranthemum* L.

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

Ohwi (1965) explored and enumerated the flora of Japan and reported that there were 5 genera, 7 species, 3 varieties; i.e. *Strobilanthes japonica* (Thunb.) Miq., *S. cusia* (Nees) O. Kuntze., *S. oligantha* Miq., *Codonacanthus pauciflorus* (Nees) Nees, *Hygrophila lancea* (Thunb.) Miq., *Dicliptera japonica* (Thunb.) Makino var. *subrotunda* Matsuda, *D. japonica* (Thunb.) Makino var. *japonica* and *Justicia procumbens* L. var. *leucantha* Honda

Hara (1966) explored and enumerated the flora of Eastern Himalaya. The Acanthaceae were recorded 40 taxa: subtribe *Ruelliinae* has 7 genera, 21 species as follow: *Echinacanthus attenuatus* Nees, *Eranthemum nervosum* (Vahl) R. Br., *Eranthemum strictum* Colebr. ex Roxb., *Hemigraphis latebrosa* Nees, *Hygrophila polysperma* T. Anderson, *Hygrophila salicifolia* (Vahl) Nees, *Hygrophila spinosa* T. Anderson, *Cardanthera triflora* (Roxb.) Ham. ex C. B. Clarke (=*Hygrophila*), *Phaylopsis parviflora* Willd., *Ruellia tuberosa* L., *Strobilanthes agrestis* C. B. Clarke, *S. atropurpureus* Nees, *S. auriculatus* Nees var. *edgeworthianus* (Nees) C. B. Clarke, *S. capitatus* (Nees) T. Anderson, *S. coloratus* (Nees) T. Anderson, *S. divaricutus* (Nees) T. Anderson, *S. glutinosus* Nees, *S. lamiifolius* (Nees) T. Anderson, *S. pentstemonoides* (Nees) T. Anderson, *S. urophyllus* (Walt.) Nees and *S. wallichii* Nees.

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Hansen (1985) studied 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.

Wood (1994) explored and enumerated the *Strobilanthe*s Blume in the flora of Bhutan. There were separated to 16 groups and recorded 30 species; i.e. *S. khasayana* (Nees) T. Anderson, *S. frondosa* J.R.I. Wood, *S. himalayana* J.R.I. Wood, *S. tubiflos* (C.B. Clarke) J.R.I. Wood, *S. acrocephala* T. Anderson, *S. rubescens* T. Anderson, *S. sabiniana* (lindley) Nees, *S. saccata* J.R.I. Wood, *S. tamburensis* C.B. Clarke, *S. auriculata* Nees, *S. aenobarba* W.W. Sm., *S. cyphantha* Diels, *S. helicta* T. Anderson, *S. inflata* T. Anderson, *S. oresbia* W.W. Sm., *S. tibetica* J.R.I. Wood, *S. urophylla* (Nees) Nees, *S. versicolor* Diels, *S. wallichii* Nees, *S. attenuata* (Nees) Nees subsp. *attenuata*, *S. attenuata* subsp. *nepalensis* J.R.I. Wood, *S. claviculata* C.B. Clarke ex W.W. Sm., *S. extensa* (Nees) Nees, *S. lachenensis* C.B. Clarke, *S. subnudata* C.B. Clarke, *S. lamiifolia* (Nees) T. Anderson, *S. nutans* (Nees) T. Anderson, *S. angustifrons* C.B. Clarke, *S. bracteata* (Nees) J.R.I. Wood, *S. geniculata* C.B. Clarke, *S. multidens* C.B. Clarke, *S. oligocephala* C.B. Clarke, *S. pentstemonoides* (Nees) T. Anderson var. *pentstemonoides*, *S. pentstemonoides* (Nees) T. Anderson var. *dalhousieana* (Nees) J.R.I. Wood, *S. pubiflora* J.R.I. Wood, *S. anisophylla* (G. Lodd.) T. Anderson, *S. campaniformis* J.R.I. Wood, *S. discolor* (Nees) T. Anderson, *S. divaricata* (Nees) T. Anderson, *S. hamiltoniana* (Steud.) Bosser & Heine, *S. oxycalycina* J.R.I. Wood, *S. scoriarum* W. W. Sm., *S. thomsonii* T. Anderson, *S. secunda* T. Anderson, *S. aborensis* Dunn, *S. elongata* C.B. Clarke, *S. tenax* Dunn, *S. cusia* Nees, *S. glutinosa* Nees, *S. accrescens* J.R.I. Wood subsp. *accrescens*, *S. accrescens* subsp. *teraoi* J.R.I. Wood, *S. capitata* (Nees) T. Anderson, *S. echinata* Nees, *S.glomerata* (Nees) T. Anderson, *S. kingdonii* J. R. I. Wood, *S. simonsii* T. Anderson, *S. bheriensis* (Shakya) J.R.I. Wood, *S. cuneata* (Shakya) J.R.I. Wood, *S. hygrophiloides* C.B. Clarke ex W.W. Sm., *S. jennyae* J.R.I. Wood, *S. macrostegia* (Nees) C.B. Clarke and *S. mekongensis* W.W. Sm.

Scotland and Vollesen (2000) studied in the family Acanthaceae through the pollen morphology, corolla aestivation, and phylogeny. It was classified by retinacula

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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.

The Forest Herbarium (2001) recorded 8 genera 25 species in Thai Plant Names Tem Smitinand, Revised-Edition. Dyschoriste Nees recorded 1 taxa: *D. depress* Nees Ya sam chan (Prachin Buri), Ae tu kok, Sa bi nam (Loei). *Eranthemum* L. recorded 2 taxa: *E. ciliatum* (Craib) Benoist, Khem phuang (Bangkok); Cha hom (Chiang Mai) and *E. nervosum* R. Br. ex Roem. & Schult. Khem khiao, Khem phaya in, Khem muang (Bangkok). *Hemigraphis* Nees (= Strobilanthes Blume) recorded 3 taxa: *H. alternata* T. Anderson Dat ta kua, Hom khrang (Northern), Ruesi phasom laeo (Central), Hong-chi-ang (Chinese). (syn. *H. colorata* Blume); *H. repanda* Hallier f. Rip bin dam (Bangkok) and *H. sumatrensis* (Heyne ex Roth) Boerl. ex Bremek. var. *sumatrensis* Ya ya ngu (Satun). *Hygrophila* R. Br. recorded 3 taxa: *H. erecta* (Burm. f.) Hochr. (syn. *H. quadrivalvis* Nees) Toi ting, Toi ting thai, Toi ting na (Bangkok), Nam dap fai (Prachuap Khiri Khan); *H. incana* Nees, Fai duean ha (Nakhon Ratchasima), Ya sapka (Ang Thong); *H. phlominoides* Nees sam sam (Loei). *Phaulopsis* Willd. recorded 1 taxa: *P. dorsiflora* (Retz.) Samtapau Nam mok bo wai (Nakhon Ratchasima). *Ruellia* L. recorded 4 taxa: *R. amoena* L. Daeng silon (Central), Red christmas pride; *R. colorata* L. Daeng ameson (Central); *R. repens* L. Cha hom, Fa maeng (Nakhon Ratchasima), Toi ting lueai (General), *R. tuberosa* L. Toi ting (Bangkok). *Sericocalyx* Bremek. (=*Strobilanthes* Blume) recorded 2 taxa: *S. quadrifarius* (Wall.ex Nees) Bremek. Tin tang tia, Sati nam (Loei), Hom dong (Chiang Mai) and *S. schomburgkii* (Craib) Bremek. (syn. *H. schomburgkii* Craib) Kha kai, Khaeng kai (Bangkok). *Strobilanthes* Blume recorded 9 taxa: *S. apica* (Hance) T. Anderson Phaya sam rak, Yo thong (North, Northeastern), *S. auriculata* Bremek. Cha hom (Lampang), *S. bibracteata* Blume Khram ngae (Pattani), *S. cusia* (Nees) Kuntze Khram (General), Khram loi (Shan-Mae Hong Son), Hom (Northern), Hom mueang (Nan), *S. cystolithigera* Lindau Samong kong (Nakhon Ratchasima), *S. Dyeriana* Bremek. Nak boriphat, Nak benchaphan (Bangkok), *S. nivea* Bremek. Niam suan

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(Bangkok); Om (Nakhon Ratchasima), *S. siamensis* Bremek. Khok ma taek, Ya lek na pa (Chiang Mai) and *S. suborbicularis* (Imlay) Bremek. Wan khruea on (Chiang Mai).

Chaikong (2001) studied in the subtribe Barleriinae (Acanthaceae) in Northeastern Thailand. The morphological characters, ecology, distribution, vernacular names and medicinal uses were studied. It was reported that there were 6 genera 17 species, i.e. *Asystasia gangetica* T. Anderson, *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* J.B. Imlay, *P. carruthersii* Guill., *P. couderci* R. Ben., *P. graciliflorum* Radlk., *P. parishii* (C.B. Clarke) Lindau, *P. reiculatum* (Hort. ex Gard.) Radlk., *P.* sp.1 and *P.* sp.2

Bennett and Scotland (2003) revised the species of *Strobilanthes* Blume in Java and 25 species are recognized, i.e. *S. afriastiniae* J.R. Benn., *S. alata* Blume, *S. autapomorpha* J.R. Benn., *S. axilliflora* S. Moore, *S. backeri* (Bremek.) J.R. Benn., *S. bibracteata* Blume, *S. bonolensis* Merr., *S. cernua* Blume, *S. coerii* J.R. Benn., *S. filiformis* Blume, *S. glandulosa* Blume, *S. glomerata* (Nees) T. Anderson, *S. hamitoniana* (Steud.) Bosser & Heine, *S. involucrata* Blume, *S. koordersii* Koord., *S. moschifera* Blume, *S. paniculata* (Nees) Miq., *S. parabolica* Nees, *S. pedunculosa* Miq., *S. repanda* (Blume) J. R. Benn., *S. speciosa* Blume, *S. steenisiana* J.R. Benn., *S. stenura* (Bremek.) J.R. Benn., *S. warburgii* J.R. Benn. and *S. winckelii* (Bremek.) J.R. Benn. The 2 new species are described (*S. afriastiniae*, *S. Steenisiana*), and the 5 species are founded in Thailand, i.e. *S. hamitoniana*, *S. moschifera*, *S. paniculata*, *S. repanda* and *S. speciosa*.

Wood and Scotland (2003a) reported the species of *Strobilanthe*s Blume from East Asia with a paniculate inflorescence form. The 16 species are enumerated. The new species are described and discussed. Three new species, *Strobilanthes ramosissima* (from Sumatra), *S. tenuiflora* (from Thailand) and *S. euantha* (from the China-Burma (Myanmar) border region) are described, a new name *S. bunnemeyeri* is provided for *Diflugossa glandulosa*, and the new combinations *S. ovatifolia* and *S. pubescens* are made.

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Wood and Scotland (2003b) reported and presented distribution of the 2-lipped species of *Strobilanthes* Blume 11 species are founded in Thailand, *S. rufrescens* (Roth) T. Anderson subsp. *parishii*, *S. rufrescens* (Roth) T. Anderson subsp. *paribracteata*, *S. auriculata* Nees var. *dyeriana* (syn. *S. siamensis*), *S. helferi* T. Anderson, *S. decumbens* (Bremek.) J.R.I. Wood comb. nov., *S. heliophila* J.R.I. Wood, sp. nov., *S. repanda* (Blume) J. R. Benn., *S. alboviridis* J.B. Imlay, *S. maxwellii* J.R.I. Wood, sp. nov., *S. peninsularis* Terao and *S. lilacina* C.B. Clarke

Kress *et al.* (2003) reported the checklist of the Acanthaceae in the plants of Myanmar. There are recorded 278 species and the subtribe Ruelliinae *sensu* Scotland and Volesen (2000) are recorded total 116 species; i.e. *Aechmanthera tomentosa*, *Cardanthera avana, C. griffithii* (=*Hygrophila* R. Br.), *Daedalacanthus ciliatus*, *D. microstachyus* (=*Eranthemum* L.), *Dipteracanthus longifolia* (=*Ruellia* Willd.), *Eranthemum album, E. angustifolium, E. blumei, E. ciliatum, E. griffithii, E. indicum, E. macrophyllum, E. montanum, E. polyneurum, E. pulchellum, E. purpurascens, E. splendens, E. strictum, E. suffruticosum, E. tapingense, E. tetragonum, E. tubiflorum, E. wardii, E. wattii, Hemigraphis alternata, H. elegans, H. flaccida, H. flava, H. glaucescens, H. griffithiana, H. quadrifaria, H. auriculata, H. difformis, H. dimidiata, H. phlomoides, H. polysperma, H. quadrivalvis, H. salicifolia, H. schulii, Phaulopsis dorsiflora, Ruellia ciliata, R. macrosiphon, R. patula, R. repens, R. tuberosa, Strobilanthes acrocephala, S. acuminatus, S. aenobarba, S. angustifrons, S. apricus, S. arenicola, S. auriculatus, S. birmanica, S. brandisii, S. calvata, S. candida, S. capitatus, S. congesta, S. conatus, S. crataegifolius, S. cusia, S. crystolithigera, S. dalzielii, S. dasyspermus, S. debilis, S. extensa, S. falconeri, S. farinosus, S. fimbriata, S. flaccidifolius, S. foetidissima, S. frondosa, S. fructicosa, S. glandulosus, S. glomeratus, S. gregalis, S. hamiltoniana, S. haplanthoides, S. helferi, S. hossei, S. imbricatus, S. imlayae, S. inflate, S. kunthianus, S. lamifolius, S. lamioides, S. lanceifolius, S. longipes, S. maclellandi, S. microcarpa, S. mogokensis, S. nagaensis, S. neesii, S. obtusibracteata, S. oresbia, S. panichanga, S. paniculata, S. parishii, S. paucinervis, S. pectinatus, S. pentstemonoides, S. perfoliatus, S. phyllostachyus, S. rex, S. rosea, S. rufescens, S. scaber, S. serrata,*

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S. setosa, S. shanensis, S. simonsii, S. stramineus, S. unilateralis, S. wallichii and *S. yunnanensis*.

Sarawichit *et al.* (2006) studied in the subtribe Justiciinae (Acanthaceae) in Northeastern Thailand. Three genera and eighteen species are enumerated; *Justicia adhatoda, J. betonica, J. cochinchinensis, J. diffusa, J. gendarussa, J. kampotiana, J. modesta, J. procumbens, J. quadrifaria, J. remotifolia, J. stolonifera, J. ventricosa, J.* sp.1, *J.* sp.2, *J.* sp.3, *J.* sp.4, *Rhinacanthus nasutus* and *Rungia pectinata*.

10. Uses

Singh and Handa (1995) reported that a significant hepatoprotective activity of the methanolic extract of the seeds of *Hygrophila auriculata* (K. Schum.) Heine (syn. *Asteracantha auriculata* Nees), as used in Indian systems of medicine for the treatment of liver ailments.

Mitscher and Baker (1998) reported that Tryptanthrin, an alkaloid for the Chinese herb *Strobilanthes cusia,* conventional and combinatorial matrix synthesis methodologies allowed the construction of hundreds of analogs in an attempt to optimize the activity. Trptanthrin and its analogs are potent against multi-resistant tuberculosis strains, are non toxic and give promising blood and tissue levels after oral administration to mice.

Ismail *et al.* (2000) reported that the components present in and total antioxidant activity of leaves of *Strobilanthes crispus* (L.) Bremek. (syn. *Sericocalyx crispus* (L.) Bremek.). Specially, Catechins of *S. crispus* leaves showed highest antioxidant activity when compared to Yerbamate and vitamin E. Consumption of the leafy extract daily (5 g/day) as an herbal tea could contribute to the additional nutrients and antioxidants needed in the body to enhance the defense system, especially toward the incidence of degenerative diseases.

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Hu *et al*. (2001) reported that the bioactivity from the extract of *Strobilanthes auriculatus*, which used as traditional Chinese medicine against Pyricularia oryzae.

Ho *et al*. (2003) reported that the leaf of *Strobilanthes cusia*, popularly known as Da-chin-yeh, has been commonly used in traditional Chinese medicine. It is used for influenza, epidermic cerebrospinal meningitis B, viral pneumonia and mumps. It is also used to treat sore throat, aphthae and inflammatory diseases with redness of skin. They evaluated the antinociceptive, anti-inflammatory and antipyretic effects of methanol extract of *S. cusia* leaves in male mice and rats.

Singh *et al.* (2002) investigated the anti-flammatory and antimicrobial activities of triterpenoids from *Strobilanthes callosus* Nees., 95 % ethanol extract, benzene fraction. And confirmed that the use in folk medicine as an anti-inflammatory and antimicrobial herbal drug in India.

Copp (2003) reported that Tryptanthrin, an indoloquinazolinone alkaloid isolated from the Chinese medicinal plant *Strobilanthes cusia*, exhibited growth inhibition of *Microbacterium tuberulosis*, *M. avium* complex and *M. smegmatis* with MIC values of 1, 4 and 6 µg ml $^{-1}$ respectively.

Tanaka *et al*. (2004) reported that the root of *Strobilanthes cusia* Bremk. (Acanthaceae), populary known as Da-Ching-Yen, has been commonly used in traditional Chinese medicine. It is used to treat influenza, epidemic cerebrospinal meningitis, encephalitis B, viral pneumonia, mumps and severe acute respiratory syndrome (SARS).

Sawadogo *et al*. (2006) studied the total phenolic and flaonoid content as well as the antioxidant activity of six Acanthaceae from Burkina Faso, *Hygrophila auriculata* (Schumach.) Heine and *Dyschoriste perrottetii* (Nees) O. Ktze were evaluated, too. Their aqueous acetone extract were assessed by Folin-ciocalteu and $AlCl_3$ method. *H. auriculata* was found to possess the best antioxidant activity and support it use in cardiovascular and anti-inflammatory diseases.

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Samy (2005) studied antimicrobial activity of some medicinal plants from Indian and reported that the methanol extracts of *Asteracantha longifolia* L. (=*Hygrophila* R. Br.) was significantly active against the bacteria gram (-) and garm (+) studied.

Shammugasundaram and Venkataraman (2005) reported that *Hygrophila auriculata* (K. Schum) Heine (syn. *Asteracantha longifolia* Nees) was described in ayurvedic literature as Ikshura, Ikshugandha and Kokilasha. This plant was extensively used in traditional system of medicine for various ailments like rheumatism, inflammation, jaundice, hepatic obstruction, pain, etc. And the aqueous extract of aerial parts and root exhibited anti-nociceptive activity by central and peripheral mechanisms in mice.

Chen *et al.* (2006) reported that the antioxidant activity of *Ruellia tuberosa* L. The methanolic extract and its four fractions of water, ethyl acetate, chloroform and n-hexane were prepared and then subjected to antioxidant evaluation. Which the results provide useful information on the pharmacological activities associated with free radicals of this traditional folk remedy.

Liau *et al.* (2006) reported that *Strobilanthes cusia* is biennial herbaceous plants widely distributed in Asia. Their leaves and roots known as Banlangen, respectively, has been used in traditional Chinese medicine (TCM) for hundreds of years as antipyretic, antiviral, anti-inflammatory, and anti-influenza agents. During the outbreak of severe acute respiratory syndrome (SARS) in 2003, Banlangen was prescribed to treat patients in China although there was no medicinal evidence suggesting the applicability.

Shammugasundaram and Venkataraman (2006) reported that *Hygrophila auriculata* (K. Schum) Heine was widely used in the Indian-systems of medicine for the treatment of various liver ailments. The aqueous extract of the roots exhibited significant of hepatoprotective and antioxidant activities.

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MATERIALS AND METHODS

1. The morphology of the subtribe Ruelliinae (Acanthaceae) in Thailand

Measurement of vegetative and reproductive features of plants were carried out using a hand ruler or scale calibrated in cm and mm under the stereomicroscope. The morphological characters are described in full detail. Illustrations and photographs are provided for clarification. The herbarium specimens and voucher specimens were identified with the aid of taxonomic literatures and comparison with the type specimens. Key to the species based on their significant morphological characters will be constructed. Distribution and some ecological information will be provided for all species. The dried specimens will be mounted on herbarium sheets, labelled, registered and deposited in BKF, BK and herbarium of Botany Department, Faculty of Science, Kasetsart University.

2. Palynology of the subtribe The Ruelliinae (Acanthaceae) in Thailand

Pollen material were obtained from voucher specimens. And examined both with the light microscope (LM) and scanning electron microscope (SEM). For LM, pollen will be acetolysed by using the technique of Erdtman (1954), mounted in silicone oil, and sealed with paraffin. The following characters were measured from fifteen pollen grains: size in diameter and spine length (µm). For SEM, pollen will be directly collected from dried specimens. Pollen was dried by critical point drying (CPD) and affixed to aluminum stubs with double side cellophane tape. Pollen was sputter-coated with gold pallidium mixture, and examined with SEM at the Electron Microscopy laboratory, Central laboratory, Kasetsart University.

3. Taxonomic studies of the subtribe Ruelliinae (Acanthaceae) in Thailand

1. The literature and herbarium specimens of the subtribe *Ruelliinae* available in the herbarium of the the forest herbarium, Royal Forest Department (BKF.); Bangkok Herbarium, Department of Agriculture (BK); The Herbarium of The Natural History Museum, London, UK (BM); Kew Herbarium Royal Botanic Gardens,

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London, UK (K); Prince of Songkhla University Herbarium (PSU); herbarium of phamacy faculty, herbarium of sciences faculty, Chiang Mai University (CMU) and herbarium of Saun Laung Rama 9 (SLR) were studies.

2. Field collections and phenological observations of the the subtribe Ruelliinae will make throughout the country. Reproductive material is collected with six to eight duplicates, pressed, dried and frozen at -40°C (to kill insects) and stored at the herbarium of Botany department, faculty of sciences, Kasetsart University.

3. The data of the specimens in the herbarium will compile including notes obtain from its locations. The specimens with the aid of taxonomic literatures and references will be identified, compared with the specimens at Thai herbaria, and also abroad herbaria.

4. The keys base on their significance characters will be made and the thaxonomic characters of each species will be described in details supporting by line drawing, photograph and distribution maps.

5. The hebarium specimens will be mounted and labeled then register, and will be kept in their respective order at the BKF, BK, and Kasetsart University. The dulplicate of specimens will disperse to another Thai herbaria and abroad herbaria for futher study.

4. The biological activities of the subtribe Ruelliinae (Acanthaceae) in Thailand

1. Air-dried plant samples (200-300 g. dried weight) were sequentially extracted with dichloromethane and methanol.

2. The dichloromethane and methanolic extracts are evaporated to dryness, to give a dichloromethane and methanol crude extract, respectively.

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3. Both dichloromethane and methanolic extracts are evaluated for anti-cancer property at Chulabhorn Research Institute (CRI.)

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RESULTS AND DISSCUSION

In this study, Ruelliinae were investigated throughout in natural habitat and herbarium specimens a were devided into 4 parts which consisted of the morphology characters in Ruelliinae, Acanthaceae in Thailand, The palynology of the subtribe Ruelliinae (Acanthaceae) in Thailand, taxonomic studies of the subtribe Ruelliinae (Acanthaceae) in Thailand and the biological activities of the subtribe Ruelliinae (Acanthaceae) in Thailand were investigated at Natural Products Laboratory, Chulabhorn Research Institute (CRI).

1. The morphology characters in Ruelliinae, Acanthaceae in Thailand

"Purple-tube flowers" is the most attractive and easy to recognize for Ruelliinae, are variable of morphological characters. Ruelliinae are presented since from sea level to the highest level of altitude of mountain in Thailand i.e. Doi Inthanon, Doi Chaingdao (ca 2,550 and 2,325 m sea level).

1.1 Live form and Vegetative

Most of Ruelliinae are presented as terrestrial plants and found some species are hygrophilous [moisture-loving] or aquatic plants i.e genus *Hygrophila* and *Hemigraphis repanda* (an unplaced species in *Strobilanthes*), occationally, underwater-vegetative parts showing the different in shapes and sizes. The terrestrial plants have a range from annual or periannual herb to shrubs, suffrutescens [slightly woody, perennial plant with only lower part woody]. Some species of Strobilanthes have long been noted for their monocarpic, or more strictly "plietestial", character that is they grow for a period of 10-15 years, flower gregariously and the die, in much the same as bamboos (i.e. *S. echinata*). The leaves are simple, mostly opposite and decussate same as the main features of plant in family Acanthaceae. The occurrence of isophyllous [with equal leaves and anisophyllous [with unequal leaves] can be useful to classification in genus *Strobilanthes*. The blades are variable form narrowly linear, elliptic, lanceolate to broadly obovate, petiolate or sessile to subsessile.The size of

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blade rang from small blades ca. 1.5-3.5 by 1-2 cm in *Ruellia repens* to largest blades ca. 5.5-30 by 4-15 cm in *Diceratotheca bracteolata*. The apices vary from acute to acuminate. The margins are normally entire but some species distinghtly undulate (i.e. *S. repanda*). Leaves surfaces are glabrous or hairy which presented cystoliths all species. The texture of the leaves are chartaceous or subcoriaceous which turn to be chartaceous when dry (i.e. *Sanchizia oblonga*).

1.2 Inflorescence

The inflorescences are appeared in axillary or terminal, reduced or expanded dichasia, sometimes forming dichasiate spikes, thyrses, or panicles, sometimes reduced to a solitary flower. The basic pattern is varies type, generally helps to characterize different species. Sessile cluster of flower, 1-5 flowers are grouped in axil of the upper leaves as in *Dyschoriste erecta* and *Ruellia* sp. Spikes type is the most outstanding of genus *Eranthemum*.

1.3 Calyx

The Calyx always 5-lobed, equal or subequal, usually deeply lobes to the base.

1.4 Corolla

The corolla is sympetalous, usually 5-merous, mostly zygomorphic, and commonly 2 lipped or bilabiate, e.g., in *Ruellia* in such cases the upper lip of the corolla is erect and bifid at the apex and the lower lip is horizontal and three-lobed forming the landing-platform for the insects. Usually the corolla possesses a large or short slender corolla tube which passes above into an equally five lobed limb. The inner side of the lip of the corolla possesses dense hairs. These hairs often extend to the mouth of the corolla. The aestivation is contorted. The color of corolla variety of purple or violet, white, yellow, and pink.

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1.5 Androechium

The androecium usually consists of 4 didynamous stamens or only 2 stamens (rarely 5) adnate to the corolla tube or epigynous zone, alternate with the lobes. In certain cases only two stamens are found. In the cases where there are only four stamens, the fifth posterior stamen reduces to a staminode or disappears completely. The anthers may be two or one celled. In case where on celled anthers are found, a rudiment of the second cell may be seen, whereas, in case of two-celled anthers, the cells are equal and more or less separated by a connective. Sometimes the lower cell of the anther becomes spurred. The shape and size of pollen grains are quite different from genus to genus.

1.6 Gynoechium

The gynoecium consists of a single compound pistil of 2 carpels, syncarpous. The superior ovary, bilocular, two or more ovules are found in each locule, axile placentation. The style is long and slender, projects out from the mounth of the corolla tube. There are two small stigmas, and the posterior stigma is usually reduced. An annular nectary disk is usually found around the base of the ovary.

1.7 Fruits and Seeds

All species have a biloculate, 2 valve, loculicidal capsule. Reticula present in all species. Most of Rueliinae have septa with attached reticula remaining attaced to inner wall of mature capsule, excepted *Ruellia blechum*. Capsules always found in oblong, claviform or spindal shape.

1.8 Distribution of Ruelliinae, Acanthaceae in Thailand

The Ruelliinae, Family Acanthaceae in Thailand comprises 9 genera, 74 species and 77 taxa. *Strobilanthes* is the largest of 49 species and 52 taxa, occurs widespread within 7 floristic regions of Thailand, which are 61 species in the Northern

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region (N), 32 species in the NorthEastern (NE), 21 species in the Eastern (E), 17 species in the South-Eastern (SE), 38 species in the South-Western (SW), 18 species in the Central (C) and 33 species in the Peninsular (PEN).

Table 1 Distribution of the Ruelliinae, Acanthaceae in Thailand.

Species	Conservation Status	Thailand Floristic Regions						
		N	NE	E	SE	SW	C	PEN
1. Clarkesia J. R. I. Wood								
1) *C. parviflora*	(VU)[5]	X				X		
2. Diceratotheca J. R. I. Wood								
1) *D. bracteolata*	(EN)[2]	X						
3. Dyschoriste Nees								
1) *D. erecta*		X	X	X	X	X		X
4. Eranthemum L.								
1) *E. ciliatum*		X	X					
2) *E. macrophyllum*		X						
3) *E. obovatum*		X	X			X	X	
4) *E. strictum*	(VU)[5]		X		X			
5) *E. suffruticosum*					X	X		X
6) *E. tetragonum*		X	X	X		X		X
5. Hygrophila R. Br.								
1) *H. biplicata*	(VU)[5]	X			X			
2) *H. corymbosa*		X	X	X		X	X	X
3) *H. erecta*		X			X	X	X	X
4) *H. phlomoides*			X	X	X			X
5) *H. polysperma*		X						

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Table 1 (Continued)

Taxa	Conservation Status	Thailand Floristic Regions						
		N	NE	E	SE	SW	C	PEN
6) *H. ringens* var. *ringens*		X			X	X	X	X
6. Phaulosis Willd.								
1) *P. dorsiflora*		X		X		X	X	X
7. Ruellia L.								
1) *R. bella*	(R)[5]	X				X		
2) *R. blechum*		X						
3) *R. kerrii*	(VU)[5]	X		X		X	X	
4) *R. macrosiphon*	(VU)[5]	X				X		
5) *R. patula*	(VU)[5]	X	X			X		
6) *R. repens*		X	X	X		X	X	X
7) *R. simplex*							X	
8) *R. tuberosa*		X			X	X	X	X
8. Sanchizia Ruiz&Pav.								
1) *Sanchezia oblonga*								X
9. Strobilanthes Blume								
1) *S. abbreviata*		X	X	X	X	X		X
2) *S. alboviridis*					X	X		X
3) *S. alternata*						X	X	X
4) *S. anamitica*	(VU)[5]	X				X		
5) *S. aprica*	(VU)[5]	X	X			X		
6) *S. argentea*	(EN)[5]	X						
7) *S. auriculata*								
7a) var. *auriculata*		X	X		X	X	X	
7b) var. *dyriana*		X						
8) *S. bilabiata*	(EN)[5]	X						
9) *S. brandisii*		X	X	X	X	X	X	X
10) *S. chiangdaoensis*	E[1]	X						
11) *S. chinensis*		X	X	X	X	X	X	X
12) *S. confinis*			X				X	X
13) *S. consors*		X	X			X		
14) *S. corrugata*	(EN)[5]	X						
15) *S. cruciata*	(DD)[4]	X	X					X

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Table 1 (Continued)

Taxa	Conservation Status	Thailand Floristic Regions						
		N	NE	E	SE	SW	C	PEN
16) *S. cusia*		X	X X	X X		X	X	X X
17) *S. dalzielii* var. *inaqualis*	(EN)[4]	X						
18) *S. decumbens*	(VU)[5]	X				X		
19) *S. denticulata*	(VU)[5]					X		
20) *S. dimorphotricha*	(VU)[5]							
20a) subsp.*Dimorphotricha*		X	X					
20b) subsp. *Rex*		X	X	X		X		X
21) *S. echinata*		X	X	X	X	X	X	X
22) *S. erecta*	(VU)[5]	X		X				
23) *S. fragrans*	(EN)[4]	X						
24) *S. glaucescens*		X	X	X		X	X	X
25) *S. hamiltoniana*							X	
26) *S. helferi*	(VU)[4]	X					X	
27) *S. heliophila*	(VU)[4]							X
28) *S. hispidula*	(VU)[5]	X						
29) *S. hossei*	(VU)[5]	X	X				X	X
30) *S. imbricata*		X	X			X		X
31) *S. karensium*	(VU)[5]	X	X					
32) *S. lanceifolia*		X			X	X		X
33) *S. maxwellii*	(VU)[5]					X		X
34) *S. microcarpa*	(VU)[5]					X		
35) *S. moschifera*	(VU)[5]				X			
36) *S. palawanensis*	(VU)[5]							X
37) *S. paniculata*	(VU)[5]							X
38) *S. pateriformis*		X	X		X			X
39) *S. pedunculosa*	(VU)[5]					X		
40) *S.quadrifaria*		X	X	X		X		
41) *S. repanda*		X	X	X	X	X	X	
42) *S. reptans*							X	
43) *S. rivularis*	(EN)[4]	X						X

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Table 1 (Continued)

Taxa	Conservation Status	Thailand Floristic Regions						
		N	NE	E	SE	SW	C	PEN
44) *S. rufescens*	(VU)[5]							
44a) subsp. *Parvibracteata*					X			
44b) subsp. *parishii*		X						
45) *S. schomburgkii*		X	X	X	X		X	X
46) *S. serrata*	(VU)[5]	X	X					
47) *S. speciosa*		X	X	X		X		X
48) *S. tenuiflora*	(VU)[5]	X				X		
49) *S. tonkinensis*	(VU)[5]	X		X			X	
The unplaced species:								
50) *H. repanda*							X	

Notes: Flora Regions: N= north; NE= north-east; E= east; SE= southeast; SW= south-west; C= central Pen= peninsular; Conservation Status: (DD)=Data Deficient, very widespread but rarely collected; E= endermic; (EN)= Endanger; (VU)= Vulnerable; (2) = Santisuk *et al*. (2006); (3)= Wood *et al.* (2012); (4)=Wood and Scotland (2009); (5)=from observed by Author

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2. The palynology of the subtribe Ruelliinae (Acanthaceae) in Thailand

Table 2 summarizes of quantitative of result obtained from pollen study. The representative of each genus in Ruelliinae, *Acanthaceae* In Thailand were selected to studied in 16 species, distributed in 8 genera (excepted *Diceratotheca*) i.e. *C. parviflora*, *D. erecta, E. macrophyllum*, *E. suffructicosum, H. ringens, P. dorsiflora, R. blechum, R. kerrii, R. tuberosa, Sanchezia oblonga, Strobilanthes abbreviata, S. auriculata* var. *auriculata*, *S. chinensis*, *S. corrugata*, *S. quadrifaria* and *S. schomburgkii*. Mostly of pollen grains are generally homogenous, excepted only *H. ringens* var. *ringens* is heterogenous. They are monads, heteropolar, 3-colpate, 3-colporate, 3-porate, prolate , subprolate, subsperoidal, subprolate, prolate spheroidal, oblate spheroidal. The pollen size is medium to large (P = 31.53-84.62, E = 15.93-84.77). The exines sculpturing is reticulate, open-reticulate, bireticulate and scrabrate.

On the basis of shape class and ornamentation in the subtribes Ruelliinae, Family Acanthaceae are divided into Five distinct pollen types: i.e.

Pollen type 1: (2-aperulate, oblate spheroidal, bireticulate): *Sanchezia oblonga*

Pollen type 2: (3-porate, prolate spheroidal, less open reticulate tectum): *R. kerrii, R. tuberosa*

Pollen type 3: (3-colporate,spheroidal, open reticulate tectum): *E. macrophyllum, E. suffructicosum*

Pollen type 4: (3-colporate, prolate, reticulate tectum): *R. blechum*

Pollen type 5: (3-colporate, prolate to subprolate, with pseudocolpi and ribs): *C. parviflora, D. erecta, P. dorsiflora, Strobilanthes abbreviata, S. auriculata* var. *auriculata*, *S. chinensis, S. corrugata, S. quadrifaria* and *S. schomburgkii*.

Wood and Scoltland (2012) reported and described that genus *Diceratotheca* is new genus of *Acanthaceae*, from Thailand. The genus is characterized by having unique pollen (3-porate, spheroidal with tuberculate exine) combined with several morphological characters.

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Table 2 Pollen morphology and measurements of the subtribe Ruelliinae, Family Acanthaceae in Thailand

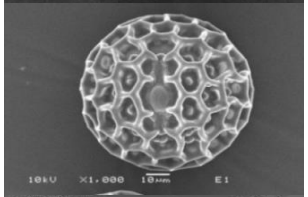
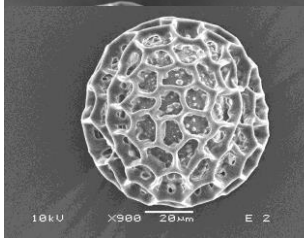
Taxa	Shape/ Type of aperture	Size (µm)		P/E	Ornamentation	SEM
		Polar axis (P)	Equatorial axis(E)			
1. *C. parviflora*	prolate/ 3-colporate	66.07±1.75	37.51±1.63	1.76	16-18 pseudocolpi, 18-20 ribs, coarsely reticulate tectum	
2. *D. erecta*	subprolate/ 3-colporate	88.62±2.15	68.00±2.38	1.30	16-18 pseudocolpi, 18-20 ribs, ribs with scrabrate tectum	
3. *E. macrophyllum*	spheroidal/ 3-colporate	86.40±0.88	84.77±0.80	1.01	open recticulate tectum with granules of exine in the lumina	
4. *E. suffructicosum*	spheroidal/ 3-colporate	84.62±1.20	80.77±1.56	1.04	open recticulate tectum with granules of exine in the lumina	

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Table 2 (Continued)

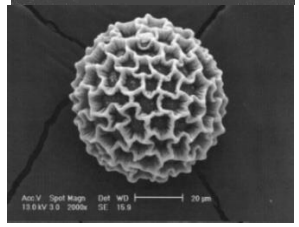
Taxa	Shape/ Type of aperture	Size (µm)		P/E	Ornamentation	SEM
		Polar axis (P)	Equatorial axis(E)			
5. *H. ringens* var. *ringens*	prolate and prolate spheroidal/ 3-colporate	P: 51.25±0.96 PS: 34.38±1.54	P: 34.38±1.45 PS: 33.75±1.20	1.49 1.01	14-16 pseudocolpi, 16-18 ribs,ribs with coarsely reticulate tectum	
6. *P. dorsiflora*	prolate/ 3-colporate	31.53±1.05	15.93±0.51	1.97	16-18 pseudocolpi, 18-20 ribs,ribs with coarsely reticulate tectum	
7. *R. blechum*	subprolate/ 3-colpate	44.44±0.53	36.11±0.67	1.23	coarsely reticulate tectum	
8. *R. kerrii*	prolate spheroidal/ 3-porate	74.40±0.95	68.00±0.86	1.09	less open reticulate tectum, with occasional small granules of exine in lumina	

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Table 2 (Continued)

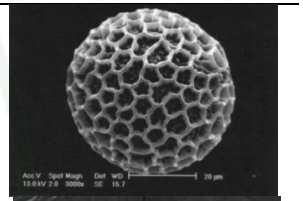
Taxa	Shape/ Type of aperture	Size (µm)		P/E	Ornamentation	SEM
		Polar axis (P)	Equatorial axis(E)			
9. *R. tuberosa*	prolate spheroidal/ 3-porate	52.63±0.50	51.58±0.49	1.02	less open reticulate tectum, with occasional small granules of exine in lumina	
10. *Sanchezia oblonga*	oblate spheroidal/ 2-colpate	84.62±10.91	44.25±6.25	0.98	20-24 ribs, coarsely bireticulate tectum	
11. *Strobilanthes abbreviata*	prolate/ 3-colporate	48.82±0.58	34.71±0.76	1.40	12-14 pseudocolpi, 14-16 ribs,ribs with coarsely bireticulate tectum	
12. *S. auriculata* var. *auriculata*	prolate/ 3-colporate	66.92±0.49	33.08±0.71	2.02	16-18 pseudocolpi, 18-20 ribs,ribs with coarsely bireticulate tectum	

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Table 2 (Continued)

Taxa	Shape/ Type of aperture	Size (μm)		P/E	Ornamentation	SEM
		Polar axis (P)	Equatorial axis(E)			
13. *S. chinensis*	subprolate/ 3-colporate	40.48±0.23	30.95±0.35	1.30	10-12 pseudocolpi, 12-14 ribs,ribs with scrabrate tectum	
14. *S. corrugata*	prolate/ 3-colporate	70.83±0.56	48.33±1.25	1.46	12-14 pseudocolpi, 14-16 ribs,ribs with coarsely reticulate tectum	
15. *S. quadrifaria*	prolate/ 3-colporate	62.31±1.17	38.46±1.25	1.62	16-18 pseudocolpi, 18-20 ribs,ribs with coarsely reticulate tectum	
16. *S. schomburgkii*	prolate/ 3-colporate	43.68±1.62	29.47±1.35	1.48	12-14 pseudocolpi, 14-16 ribs,ribs with coarsely reticulate tectum	

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3. Taxonomic studies of the subtribe Ruelliinae (Acanthaceae) in Thailand

The plant in family Acanthaceae has been studied by Joan B. Imlay (for B.Sc. Arberdeen) since 1938 in "The Taxonomy of the Siamese Acanthaceae". The plants in subtribe Ruelliinae, Family Acanthaceae are enumerated and re-studies for the Flora of Thailand account are made. There are 75 species(78 taxa) belonging to 9 genera. This study provides keys to genera and species, full description, distribution, ecological information, vernacular name and listed of specimens as follow:

CLASSIFICATION OF ACANTHACEAE

(*sesu* Scotland and Vollesen, 2000)

[Seeds on elongated, indurated, more or less hook-shaped funicles; Fruit a locuclicid capsule; Endosperm absent]

Acantanceae Juss.

Nelsonioideae Pfeiff. [reticula absent, cystoliths absent, descending coclear aestivation]

Thunbergiodeae Kostel. (including Mendoncia)[Primarily lianes, bristled anthers, poricidal opening of thecae, capsules or drupe]

Acanthoideae Dumort. [reticula and explosive capsules]

Acantheae [cystolith absent, colpate pollen, 4 monothecate anthers]

Ruellieae [Cystoliths]

Ruelliinae [Left-contort astivation and filament curtain]

Andrographinae [Daubenpollen, Ascending cochlear aestivation, usually many ovules]

Justiciinae [Ascending cochlear aestivation, 2-4 ovules, Rhamen/Spangen/Knötchen/Gürtel pollen]

Barleriinae [Quincuncial aestivation]

KEY TO GENERA OF RUELLIINAE IN THAILAND

[contorted aestivation of the corolla lobes and fused filament sheath "curtain"]

1. Corolla bilabiate ……...…...…….**5. Hygrophila**

1. Corolla subequally 5 lobed or sub-bilabiate……...…….…...(2)

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2. Corolla tube long, tubular, stamens exserted (cultivated)…….....**8. Sanchizia**

2. Corolla otherwise: verticose or campanulate, slender tube with inflated lobes…..(3)

3. Style held in place by trichomes, stamens monadelphous at base....**9. Strobilanthes**

3. Style not above……..…..……(4)

4. Capsule with elastic placentae, bracteoles absent……..……...……**6. Phaulopsis**

4. Capsule with fix placentae, ……..……....…..……..…….(5)

5. Corolla tube long with inflated lobes near the apex……..…...……**4. Eranthemum**

5. Corolla tube venticose from near the base……...……(6)

6. Anther muticous at base…….……...……...……..…**7. Ruellia**

6. Anther spurred at base…….……..……..……..……..……(7)

7. Anther two spurred ……...……**2. Diceratotheca**

7. Anther one spurred ……...……..…… (8)

8. Capsule claviform, flower in lax elongate cyme, (8-)16 seeds……...…**1. Clarkesia**

8. Capsule spindle shaped, flower in axillary, (2-)4 seeds……..……..…**3. Dyschoriste**

1. CLARKEASIA

J.R.I. Wood, Edinburgh J. Bot. 51(2): 187. 1994. Type: *Clarkeakia parviflora* (T. Anderson) J.R.I. Wood

Herbs or shrubs. *Leaves* opposite,decussate, leaf blade margin dentate. *Inflorescence*s axillary or terminal, branched cymes, bracts narrow to subleaflike, bracteoles inconspicuous or absent. *Calyx* often gland-tipped hairy, deeply 5-lobed, lobes equal or subequal. *Corolla* purple or yellow, funnel-shaped to campanulate, tube ventricose, limb 5-lobed, lobes subequal, contorted in bud. *Stamens* 4, didynamous, filaments connate at base into 2 pairs, anthers 2-thecous, thecae parallel, hirsute, spurred at base. *Ovary* with 4–8 ovules per locule, stigma 2-lobed, one lobe reduced. *Capsule* linear-cylindric tolinear-oblong, 8–16-seeded, retinacula present. *Seeds* subovate, compressed, covered with hygroscopic trichomes.

The genus *Clarkesia* J.R.I. Wood is a monotypic Asiatic genus, one species are enumerated from Thailand.

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Clarkeasia parviflora (T. Anderson) J.R.I. Wood, Edinburgh J. Bot. 51(2): 189. 1994.— *Echinacanthus parviflorus* T. Anderson in J. Linn. Soc. Bot. 9: 459. 1867. — *Strobilanthes violifolia* T. Anderson in J. Linn. Soc. Bot. 9: 485. 1867.— *E. andersonii* C.B. Clarke, Fl. Brit. India 4: 415. 1884.—*E. andersonii* var. *viscosus* C.B. Clarke, Fl. *pumilio* C.B. Clarke, Fl. Brit. India 4: 415.1884;—*E. siamensis* J.B. Imlay, Bull. Misc. Inform. Kew 1939:114. 1939.— *Pteracanthus violifolius* (T. Anderson) Bremek., Verh. Ned. Akad.Wetens.Afd. Nat. 2, 41(1): 200. 1944. (**Appendix figure 10**)

Herbs or shrubs 50–100 cm high, erect, stems quadrangular, sulcate, sparsely pubescent. *Leaves* petiolate, blades ca. 6–10 by 2–3.5 cm, lanceolate to sub-ovate, base cuneate to attenuate, apex acuminate, margin entire, lateral nerves 8–10 pairs, pubescent, hispid along veins both surfaces; petiole ca. 1-3.5 cm. *Inflorescence* spikes terminal, ca. 3.5-5.5 cm, densely flowered, bracts basally pale green and purplish red above middle, ovate to elliptic, ca. 0.5–1 by 0.2–0.4 cm, abaxially puberulent, apex acuminate, bracteoles linear, puberulent. *Calyx* 5-lobed, ca. 0.5–0.8 cm, outside puberulent, lobes linear, apex acute. *Corolla* pale white with purplish red dots or stripes on lobes, ca. 1.5 cm, outside pubescent, tube ca. 1 cm, lower lip patent, broadly 3-lobed, lobes circular, rounded and concave, apex emarginate. *Stamen* glabrous, anther thecae superposed, lower one minutely spurred at base. *Pollen* prolate, 3-colporate, P=66.07±1.75, E =37.51±1.63, P/E =1.76, 16-18 pseudocolpi, 18-20 ribs, coarsely reticulate tectum. (**Apendix Figure 20**) *Ovary* glabrous, style glabrous. *Capsule* obovoid-clavate, 1–1.2 cm, *Seeds* 8-16 seeded.

Thailand.— NORTHERN: Nan; SOUTH-WESTERN: Kanchanaburi.

Distribution.— Eastern India, Nepal, Bhutan.

Ecology.— On rocks beside stream in subtropical forest.

Conservation Status.— Vulnerable (by author).

Note.— Known only from specimens.

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2. DICERATOTHECA

J.R.I. Wood & Scotland, Kew Bull. 67(4): 692. 2012. Type: *D. bracteolata* J.R.I. Wood (Maxwell 94-1225)

Shrub. *Leaves* opposite, decussate, obovate. *Inflorescences* axillary cymes, bracts narrow, *Calyx* often gland-tipped hairy, deeply 5-lobed, lobes equal or subequal. *Corolla* purple, funnel-shaped to campanulate, ventricose, limb 5-lobed, lobes subequal, contorted in bud. *Stamens* 4, didynamous, filaments connate at base into 2 pairs, anthers 2-thecous, thecae parallel, 2 spurred at base. *Ovary* with 4–8 ovules per locule, stigma 2-lobed, one lobe reduced. *Capsule* linear-cylindric to linear-oblong, 8–seeded, retinacula present. *Seeds* subovate, compressed, covered with hygroscopic trichomes.

Endermic to Thailand, one species are reported from Thailand.

Diceratotheca bracteolata J.R.I. Wood & Scotland, Kew Bull. 67(4): 693. 2012. (**Appendix figure 11**)

Shrub with serveral stems, 1-3 m tall, erect, branched, epidermis thin, very finely roughed with fine lenticels, light brown. *Leaves* petiolate, blades 5.5- 30 by 4-15 cm, oblong-elliptic to obovate, apex acuminate, base attenuate, margin entire to obscurely undulate, glabrous; petioles ca. 5-8 cm long. *Inflorescence* flowers in solitary, axillary, subsessile, bracts 1.5-2.5 by 0.2-0.3 cm, lanceolate, pale green, bracteoles 3-5 by 0.5-0.8 cm, narrow lanceolat, attenuate to long, glabrous. *Calyx* slightly equal, ca. 1 by 0.l cm, 5-lobed, lanceolate, acute or acuminate, shortly pubescent with gland-tipped hairs, glabrous inside. *Corolla* white to purple, ca. 3-4 cm long, subequally 5-lobed, lobes ca. 0.6 by 0.8 cm, round and weakly emarginated, with dark purplish on both side. *Stamen* 4, didynamous, inserted near the base of the expanded position of the corolla tube, filaments white, 2-thecate, the base of each one with one prominent spurred, formed by a small triangular spine. *Ovary* bilocular, ca. 0.4-0.5 cm long, pubescent. *Capsule* cylindrical, ca. 2.5 cm long, shortly-pubescent. *Seeds* 8-seeded.

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Thailand.— NORTH: Mae Hong Son.

Ecology.— Mostly shaded, deciduous forest (hardwood former teak).

Vernacular.— Na bah jaw poh (Karen).

Conservation Status.— Endangered (Wood and Scotland, 2009).

3. DYSCHORISTE

Nees, Pl. Asiat. Rar. (Wallich). 3: 75, 81. 1832.— *Calophanes* D. Don, Brit. Fl. Gard., ser. 2 2: pl. 181. 1833.— *Linostylis* Fenzl ex Sond., Linnaea 23: 94.1850; — *Calophanes decumbens* A. Gray, Syn. Fl. N. Amer. 2(1): 325. 1878; Type specimens: *Dyschoriste depressa* Nees. LT designated by Britton & Brown, Ill. Fl. N. U. S., ed. 2, 3:240. 1913.

Herbs, decumbent to erect, with cystoliths, isophyllous. *Leaves* petiolate, opposite, blade lanceolate, margin entire. *Inflorescences* 1-5 flowers in axillary cymes, sometimes reduced to a single flower, sessile or subsessile, bracts small. *Calyx* deeply 5-lobed lobes equal or subequal. *Corolla* whitish to purple, tube basally cylindric, ventricose upwards, subequally, limb 2-lipped, lower lip spreading, 3-lobed, upper 2 lobed, lip and erect, margin entire to emarginated. *Stamens* anthers 2-thecous, spurred at base. Pollen "rippenpollen", grains ellipsoid or subglobose, many-banded, 3 germ-pores lying on the bands at equal intervals. *Ovary* with 2 ovules per locule, stigma entire or slightly 2-cleft. *Capsule* shortly stalked, oblong or linear, 4-seeded, retinacula present, septa separating from inner wall of mature capsule. *Seeds* compressed.

The genus Dyschoriste comprises ca. 70 species, of mostly tropical and subtropical distribution. One species are enumerated from Thailand.

Dyschoriste erecta (Burm. f.) Kuntze, Revis.Gen. Pl. 2: 485. 1891.— *Ruellia erecta* Burm. f., Fl. Indica 135. 1768.— *Calophanes crenatus* Schinz, Bull. Herb. Bossier 3: 415. 1895.— *Calophanes depressus* (L.) T. Anderson, Enum. Pl. Zeyl. 225. 1860.— *Dyschoriste cernua* Nees, *Pl.* Asiat. Rar. 3: 81. 1832.— *D. depressa* (L.) Nees, Pl.

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Asiat. Rar. 3: 81 1832.─ *Justicia mysorensis* Klein ex Schult., Mant. 1: 146. 1822.─ *R. depressa* Wall., Numer. List 2379. 1830. (**Apendix Figure 2A**)

Herb, isophyllous, erect or prostrate and roothing at nodes, young branches quadrangular, slender, pubescent along the ridge then becoming grabous. *Leaves* petiolate, blades ca. 2-5 by 1-2 cm, lanceolate, base attenuate, apex acute, margin entire, lateral nerves 5-6 pairs; petioles ca.0.2-0.5 cm long. *Inflorescence* 1-5 flowers together or solitary flower in axillary, sessile or sub sessile; bracts ca. 0.3 cm long, narrow linear. *Calyx* redish, ca. 1-1.2 cm long, linear and puberulous outside, setaceous with entire margin. *Corolla* whitish to pale purple with purple-dotted on lip-lobe, ca. 1.2-1.5 cm long, tube ca. 1-1.2 cm long, ventricose upwards, glabrous. *Stamen* didynamous, ca. 0.8-0.9 cm, from the base of the corolla tube, filament ca. 1.2-1.5 cm long, glabrous, anther mucronate at the base. *Pollen* subprolate, 3-colporate, P=88.62±2.15, E=68.00±2.38, P/E=1.30, 16-18 pseudocolpi, 18-20 ribs, ribs with scrabrate tectum. (**Apendix Figure 21**) *Ovary* glabrous, style hariy. ca. 1-1.2 cm long. *Capsule* linear, ca. 1-1.2 cm long, glabrous. *Seed* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Nan, Sukhothai, Phitsanulok; NORTH-EASTERN: Phetchabun, Loei, Sakon Nakhon, Nongkhai, Nakhon Phanom, Mukdahan; EASTERN: Chaiyaphum, Nakhon Ratchasima, SiSaKet, Ubon Ratchathani; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Petchaburi, Lop Buri, Saraburi, SOUTH-EASTERN: Sa Kaeo; PENINSULAR:Yala.

Distibution.— Cameroon, Congo, Ghana, Tanzania and Uganda.

Ecology.— Opened, shade in deciduous and evergreen forest.

Vernacular.— หญ้าสามชั้น (Ya sam chan) (Prachin Buri); อีตูโคก (Ae tu kok), สะใบน้ำ (Sa bi nam) (Loei).

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4. ERANTHEMUM

L., Sp. Pl. 1: 9. 1753.— *Daedalacanthus* T. Anderson, Enum. Pl. Zeyl. [Thwaites] 229. 1864.— *Pigafetta* Adans., Fam. Pl. 2: 223, 590. 1763.— *Upudalia* Raf., Fl. Tellur. 4: 66. 1836; Types: *Eranthemum capense* L.

Shrubs or perennial herbs, erect. *Leaves* petiolate, lanceolate to obovate, leaf blade margin entire or crenate. *Inflorescences* terminal or rarely axillary, spikes, lax, sometimes several forming a panicle, bracts sometime colored, leaf-like, large, bracteoles small, narrow. *Calyx* 5-lobed, lobes narrow, subequal. *Corolla* salveriform, tube basally cylindric, long, slender, throat sometimes inconspicuous, limb 5-lobed, lobes obovate, subequal, contorted in bud. *Stamens* 2, inserted below throat, anthers 2-thecous, thecae parallel, muticous, staminodes 2, clavate or filiform. *Ovary* 2 ovules per locule, style filiform, glabrous or pubescent, stigma 2-lobed, lobes unequal. *Capsule* with a solid stalk at base, clavate, 4-seeded, retinacula present. *Seeds* discoid, compressed, pubescent with hygroscopic trichomes.

The genus Eranthemum L. comprises ca. 30 species, of mostly tropical and subtropical distribution. Six species are enumerated from Thailand.

KEY TO SPECIES

1. Bracts crenulate, glabrous, in opposite pairs ……..……**5. E. suffruticosum**
1. Bracts entire not crenulate, glabrous or hairy …..…….……(2)
2. Stamens exserted……..……**2. E. macrophyllum**
2. Stamens not exserted……..…… ……..…(3)
3. Ovary glabrous, bracts pubescent not glandular…….……**1. E. ciliatum**
3. Ovary glandular or pubescent towards the apex……...……...……..(4)
4. Leaves blade obovate to oblong……..……..… …..**3. E. obovatum**
4. Leaves blade elliptic to lanceolate or otherwise;… ……..…(5)
5. Inflorescence long, slender, 10-15 cm……..……...……....**4. E. stritum**
5. Inflorescence 5-10 cm long,capsule gland-tipped pubescent .....**6. E. tetragonum**

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1. **Eranthemum ciliatum** (Craib) Benoist, Fl. Indo-Chine 4: 661. 1935.— *Daedalacanthus ciliatus* Craib, Bull. Misc. Inform. Kew. 1913: 202. 1913.

Herb, isophyllous, 2-30 cm high. *Leaves* petiolate, blades ca. 5-12 by 2-4 cm, elliptic-lanceolate, base cuneate or attenuate, apex obtuse, margin entire, chartaceous, glabrous, lateral nerves 5-7 pairs; petioles ca. 2-2.5 cm long. *Inflorescence* spikes solitary, terminal, sometime axillary, ca. 4-8 cm long; bracts imbricated, ovate-lanceolate, attenuate at apex, whitish with midrib and nerves green, margin conspicuously long white-cilate; bracteoles ca. 0.5 cm long. *Calyx* ca. 0.5 cm long, lobes acute, minute pubescent. *Corolla* purple, ca. 3-4 cm long, pubescent outside, tube inflated toward the apex ca. 0.5 cm. *Stamen* 2 fertile, 2 sterile, inserted on corolla tube, filament glabrous, *Ovary* glabrous, style ca. 2-3 cm long, hairy. *Capsule* ca. 1-1.5 cm long, glabrous, *Seeds* 4-seeded.

Thailand.— NORTHERN: Nan; NORTH-EASTERN: Khon Kaen.

Distribution — Myanmar.

Ecology.— Besides of stream in evergreen forest.

Vernacular.— เข็มพวง (Khem phuang) (Bangkok); จ้าห้อม (Cha hom) (Chiang Mai).

2. **Eranthemum macrophyllum** Wall. ex Nees, Pl. Asiat. Rar.3: 106. 1832.— *Daedalacanthus macrophyllus* (Wall. ex Nees) T. Anderson, J. Linn. Soc., Bot. 9: 487. 1867. (**Figure 1**; **Apendix Figure 2**B)

Shrub, anisophyllous, ca. 50-150 cm high. Stem quadrangular, pubescent. *Leaves* petiolate, blade ca. 8-15 by 4-8 cm, obovate to obovate-oblong, apex obtuse, base attenuate,margin entire, lateral nerves 10-12 pairs, chartaceous, glabrous; petioles ca. 2.5-4 cm long. *Inflorescence* spikes solitary, terminal, sometime axillary, ca. 10-20 cm long, bracts imbricated, ovate-lanceolate, attenuate at apex, whitish with midrib and nerves green, margin conspicuously long white-cilate, bracteoles ca. 0.5 cm long. *Calyx* ca. 0.5 cm long, lobes acute, minute pubescent. *Corolla* whitish to light purple,

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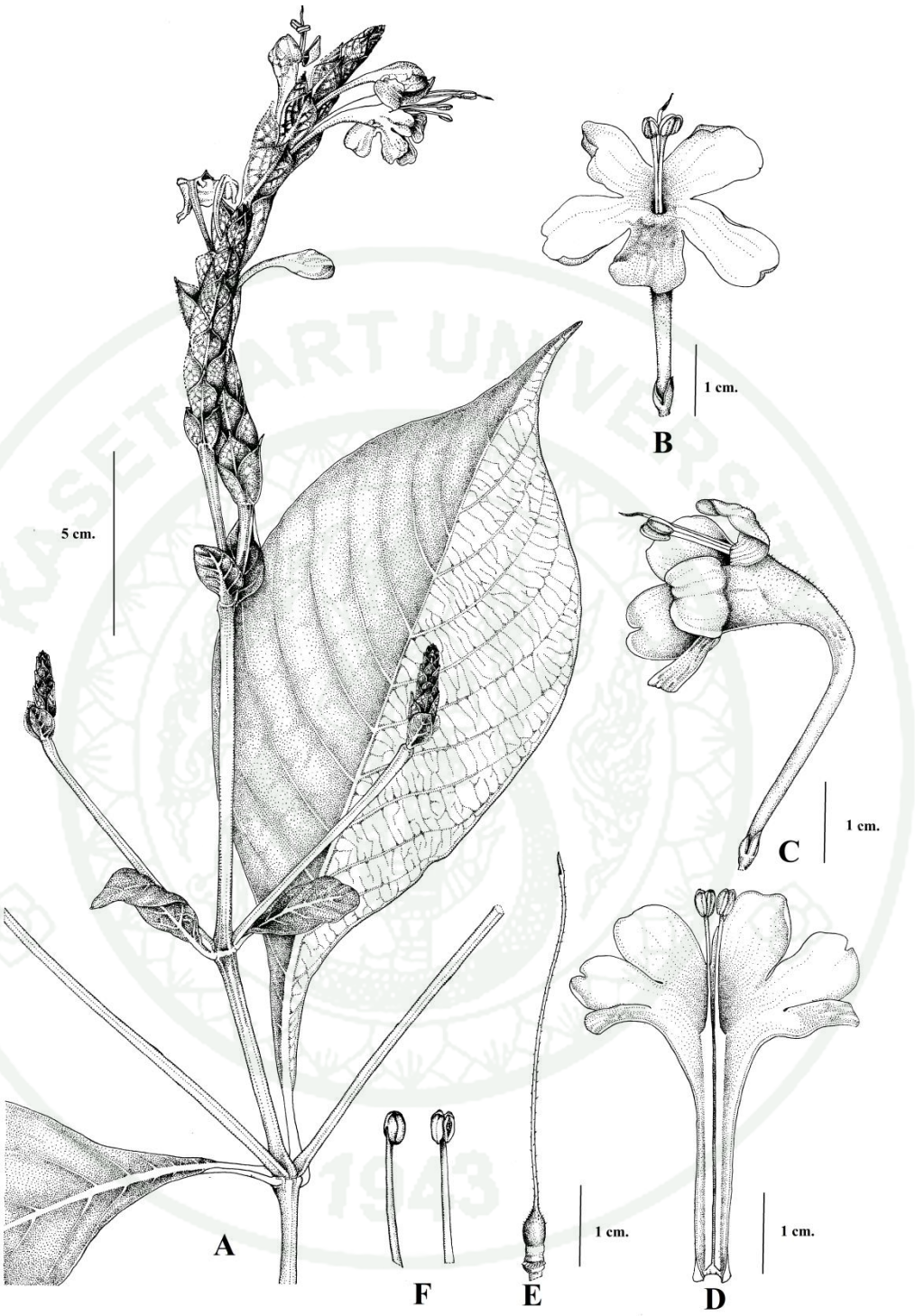

Figure 1 *Eranthemum macrophyllum* Wall. ex Nees; A. habit; B-C. flowers; D. longitudinal section of flower; E. pistil; F. stamens; Drawn by Sunti Saisuwan

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ca. 4-5 cm long, pubescent outside, tube inflated toward the apex ca. 1-1.5 cm. *Stamen* 2 fertile, 2 sterile, exserted, ca. 5-6 cm long, filament glabrous. *Pollen* spheroidal, 3-colporate, P=86.40±0.88, E=84.77±0.80, P/E=1.01, open recticulate tectum with granules of exine in the lumina. (**Apendix Figure 22**) *Ovary* glabrous, style ca.3-4 cm long, hairy. *Capsule* not seen.

Thailand.— NORTHERN: Mae Hong Son.

Ecology.— Roadsides, shade places.

Note.— Problably ornamental plant.

3. **Eranthemum obovatum** J.B. Imlay, Bull. Misc. Inform. Kew. 1939: 115. 1939.

Herb, isophyllous, ca. 10-50 cm high. *Leaves* petiolate, blades ca. 5-10 by 2-4 cm, ovate-lanceolate, base cuneate or attenuate, apex obtuse, margin entire, lateral nerves 5-7 pair, chartaceous, glabrous, petioles ca. 1-2 cm long. *Inflorescence* spikes solitary, terminal, sometime axillary, ca. 2-5 cm long, bracts imbricated, ovate-lanceolate, attenuate at apex, whitish with midrib and nerves green, margin conspicuously long white-cilate, bracteoles ca. 0.5 cm long. *Calyx* 0.5 cm long, lobes acute, minute pubescent. *Corolla* purple, ca. 3-4 cm long, pubescent outside, tube inflated toward the apex ca. 0.5 cm. *Stamen* 2 fertile, 2 sterile, inserted on corolla tube, ca. 2-2.5 cm long filament glabrous, *Ovary* glabrous, style ca. 2-3 cm long, hairy. *Capsule* ca. 1-1.2 cm long, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Chiang Rai; NORTH-EASTERN: Phetchabun; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Prachuap Kiri Khan; CENTRAL: Prachinburi.

Distribution.— Myanmar.

Ecology.— In mixed deciduous forest.

Vernacular.— เข็มม่วงใบกลม (Khem muang Bai Klom) (Chiang Rai).

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4. Eranthemum strictum Colebr. ex Roxb., Fl. Ind. Des. Vol. 21: 114. 1820.— *Daedalacanthus strictus* (Colebr. ex Roxb.) T. Anderson, J. Linn. Soc., Bot. 9: 487. 1867.

Herb, isophyllous, ca. 20-50 cm high. *Leaves* petiolate, blades ca. 3-8 by 2-3.5 cm, elliptic-oblong, base cuneate or attenuate, apex obtuse, lateral nerves 5-7 pairs, chartaceous, glabrous; petioles ca. 1-2 cm long. *Inflorescence* spikes solitary, terminal, sometime axillary, ca. 5-15 cm long; bracts imbricated, elliptic-lanceolate, attenuate at apex, whitish with midrib and nerves green, margin conspicuously long white-cilate, bracteoles ca. 0.5 cm long. *Calyx* ca. 0.5 cm long, lobes acute, minute pubescent. *Corolla* purple, ca. 3-4 cm long, pubescent outside, tube inflated toward the apex ca. 0.5 cm. *Stamen* 2 fertile, 2 sterile, inserted on corolla tube, filament glabrous, *Ovary* glabrous, style ca. 2-3 cm long, hairy. *Capsule* ca. 1 cm long, glabrous, *Seeds* 4-seeded.

Thailand.— NORTH-EASTERN: Mukdahan; EASTERN: Si Sa Ket; SOUTH -EASTERN: Prachin Buri.

Ecology.— In evergreen forest.

Conservation Status.— Vulnerable (by author).

5. Eranthemum suffruticosum Roxb, Fl. Ind.1: 112. 1820.— *Daedalacanthus suffruticosus* (Roxb.) T. Anderson, J. Linn. Soc. Bot., 9: 488. 1867.— *E. parishii* (T. Anderson) C. B.Clarke, Fl. Brit. India 4: 499 1884. (**Apendix Figure 2**C)

Herb, isophyllous, ca. 20-30 cm high, stem quadrangular, pubescent at node. *Leaves* petiolate, blades 5-12 by 4-6 cm, ovate-elliptic, base cuneate to attenuate, apex acuminate to obtuse, margin entire, lateral nerves 6-7 pairs, glabrous; petioles 2-3.5 cm long. *Inflorescence* axillary, clustered, few-flowered, bracts leaf-like in opposite pairs, 2-3 by 1.5-2 cm, rhomboid or broadly elliptic, subacute, glabrous, margin crenuate,whitish green with dark green nerve, bracteoles 0.5 cm long, linear-lanceolate, *Calyx* pubescent outside, 0.5-0.6 cm long, lobes lanceolate, unit at the base in half length. *Corolla* purple, glandular-pubescent outside, tube 3.2-3.5 cm long, slender, inflated at the apex, lobes obovate, glabrous. *Stamen* 2, staminodes 2, ca. 1.5-

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2 cm long, inserted near the apex of the corolla tube. *Pollen* spheroidal, 3-colporate, P=84.62±1.20, E=80.77±1.56, P/E=1.04, open recticulate tectum with granules of exine in the lumina. (**Apendix Figure 23**) *Ovary* glandular towards the apex, style ca. 3-3.5 cm long, pubescent. *Capsule* stalked, oblong. *Seeds* 4-seeded, round, flattened.

Thailand.— SOUTH-EASTERN: Chantaburi, Trat; SOUTH-WESTERN: Prachuap kiri khan; PENINSULAR: Panga.

Ecology.— In evergreen forest.

6. **Eranthemum tetragonum** A. Dietr. ex Nees, Prodr. Sys. Nat. Reg. Veg. 11: 454. 1847.— *Daedala canthustetragonus* (Wall. ex Nees) T. Anderson, J. Linn. Soc., Bot. 9: 488 1867.*homonym: E. tetragonum* Wall. ex Nees, Pl. Asiat. Rar. 3: 106. 1832. (**Apendix Figure 2**D)

Herb, isophyllous, perrenial, ca. 50-100 cm high, stems quadrangular, glabrous or pubescent. *Leaves* petiolate, blades ca. 5-20 by 2-5 cm, oblong, lanceolate to linear-lanceolate, base attenuate and decurrent onto petiole, apex acuminate, margin entire or crenulate, glabrous; petioles ca. 0.5-1 cm long. *Inflorescence* spikes, ca. 3–8 cm, peduncle ca. 0.2–3.5 cm, gland-tipped pubescent, bracts yellowish white with green along veins, oblong to lanceolate, ca. 1–2.2 by 0.2–0.9 cm, apex acuminate, bracteoles lanceolate, ca. 4 mm, pubescent *Calyx* 5-lobed, ca. 0.5-0.8 by 0.1-0.2 cm, outside pilose, lanceolate lobes. *Corolla* pink to purple, salvariform, ca. 3.5-4.5 cm, slender tube, lobes obovate, ca. 0.4 by 0.5 cm. *Stamen* 2-fertile, 2-sterile, ca. 0.3 cm, glbrous. *Ovary* pubescent, style hirsute, ca 0.2-0.3 cm. *Capsule* ca. 0.8-1.2 cm long, shortly grandular-pubescent. *Seeds* 4-seeded, discoid, flattened.

Thailand.— NORTHERN: Mae Hong Son, Chiengmai, Chiang Rai, Tak, Sukhothai; NORTH-EASTERN: Loei, Nongkhai, Sakon Nakhon; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Phetchaburi; PENINSULAR: Chumphon.

Distribution.— China, Indo-China and Myanmar.

Ecology.— Undershrub, along nature trail in natural forest.

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Vernacular.— เข็มเขียว (Khem khiao), เข็มพญาอินทร์ (Khem phaya in), เข็มม่วง (Khem muang) (Bangkok), ตาไก่ม่วง (Ta Kai Muang) (Chieng Rai).

5. HYGROPHILA

R.Br., Prodr. Fl. Nov. Holland. 479. 1810.— *Bahel* Adans. Fam. 2: 210. 1763.— *Nomaphila* Blume, Bijdr. Fl. Ned. Ind. 14: 804.1826.— *Asteracantha* Nees, in Wall. Pl. As. Rar.3: 75. 1832.— *Hemiadelphis*, Nees, in Wall. Pl. Asiat. Rar. 3: 75, 80. 1832.— *Tenoria* Dehnhardt & Giordano ex Dehnhardt, Cat. Pl. Hort.Camald. ed. 2: 24. 1832.— *Physichilus* Nees, Companion. Bot. Mag. 2: 310. 1836.— *Polyechma* Hochst. in Flora 24: 376. 1841.— *Adenosma* Nees, Prodr. 11: 67. 1847.— *Eberlea* Riddell, ex Nees, in DC. Prod. 11: 85. 1847.— *Cardanthera* Buch.-Ham. ex Benth. & Hook. f. Gen. Pl. 2: 1074. 1876.— *Kita* A. Chev., Rev. Int. Bot. Appl. Agric. Trop. 30: 266. 1950; Type specimens: *Hygrophila angustifolia* R. Br.

Herbs, annual or perennial, often aquatic or hygrophilous, sometimes with axillary spines, cystoliths present. Leaves sessile or shortly petiolate, leaf blade margin entire, crenulate, or sometimes undulate.Flowers sessile, in terminal spikes or several in axillary clusters, bracteoles present or absent. Calyx 5-lobed. Corolla ventricose, limb 2-lipped, lower lip 3-lobed, upper lip apex shallowly dentate, lobes contorted in bud. Stamens 2 or 4, didynamous (posterior pair similar to anterior pair or smaller), anthers 2-thecous, thecae equally inserted, staminodes 0 or 2. Ovary with 4 to many ovules per locule, stigma entire.Capsule linear**.**

About 100 species, widely distributed in tropical and subtropical regions, five species enumerated from Thailand.

KEY TO SPECIES

1. Stamens 2 .....**5**. **H. polysperma**

1. Stamens 4……..……..…..(2)

2. Flowers in terminal spikes .....**1**. **H. biplicata**.

2. Flowers in leaf axils……...……..……(3)

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3. Inflorescence cymes……..…**2. H. corymbosa**

3. Flower solitary or clustered in leaf axils……..……..……...(4)

4. Leaf blade glabrous or slightly pubescent .....**6. H. ringens**

4. Leaf blade hirsute on both surfaces…….....(5)

5. Flowers clusters with densely white-hirsute, calyx lobe subequal…….

……...**4. H. phlomoides**

5. Flowers clusters almost glabrous, calyx lobe equal……..…..**3. H. erecta**

1. **Hygrophila biplicata** (Nees) Sreem., Bull. Bot. Surv. India 10: 223. 1969. — *Adenosma biplicata* Nees, Pl. Asiat. Ra r.3: 79. 1832.— *Cardanthera avana* (Wall. ex Benth.) Benth. ex C.B. Clarke Fl. Brit. India 6. 405.— *Hygrophila avana* (Wall. ex Benth.) E. Hossain, Bangladesh J. Bot. 3(1): 48. 1974.— *Pedicularis avana* Wall. ex Benth., Numer. List [Wallich] n. 1007. 1829.— *Synnema avanum* (Wall. ex Benth.) Benth. Prodr. [A. P. de Candolle] 10: 538. 1846.— *S. biplicata* (Nees) J. B. Imlay.

Herb, annual, ca. 30 cm high, decumbent, stem quadrangular, hirsute, many grand-tipped. *Leaves* sessile or subsessile blade ca. 1.5–3.5 by 0.5–2 cm, oblong to lanceolate, base truncate to subcordate, apex obtuse, margin crenulate, lateral nerves 3–5 pairs, white pubescent below. *Inflorescence* terminal spikes, ca. 2.5–10 cm, bracts narrowly elliptic, ca. 0.5–0.6 by 0.3–0.4 cm, margin crenulate or dentate, bracteoles linear, ca. 0.8 cm long. *Calyx* whitish, glandular-pubescent outside, white hirsute, lobes linear, margin ciliate, ca. 0.6-0.8 cm. *Corolla* purple, pubescent outside, ca. 1.2-1.5 cm long, lower lip elliptic, upper lip oblong-ovate. *Stamen* 4, slightly exserted; filaments ca. 0.2-0.4 cm long. *Ovary* ca. 0.3 cm, comose, style ca. 1 cm, hirsute. *Capsule* cylindrical, ca. 0.8 cm, pubescent. *Seeds* many-seeded.

Thailand.— NORTHERN: Chiang Mai; SOUTH-EASTERN: Prachinburi.

Distribution.— China and Myanmar.

Ecology.— Paddy fields, wet places.

Conservation Status.— Vulnerable (by author).

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2. **Hygrophila corymbosa** (Blume) Lindau, Fragm. Fl. Philipp.38. 1904.**—** *Justicia stricta* (Vahl) Lindau, Symb. Bot. (Vahl) ii. 6. 1791.**—** *J. pubescens* Lam., Symb. Bot. (Vahl) 2: 9. 1791.**—** *H. stricta* Lindau**,** Nat. Pflanzenfam. [Engler & Prantl] 6: 3b: 297. 1895.**—** *Nomapila stricta* (Vahl) Nees, Prodr. 11: 84. 1847.— *N. parishii* T.Anderson, Journ. Linn. Soc. 9: 455. 1867.— *N. pupbesens* Kurze, Journ. As. Soc. Beng. 74. 1871. (**Apendix Figure 3A**)

Herb, aquatic, annual or perennial, ca. 5–20 cm high, *Leaves* petiolate, blades 3–8 by 1.5–3 cm, ovate to lanceolate, base attenuate, apex acute, margin entire, lateral nerves 9–11 pairs, papery, both surfaces densely covered with cystoliths, abaxially pilose or sometimes only hairy along veins when dry, glabrous; petioles ca.1.5–4 cm long, puberulous. *Inflorescence* cymes axillary, dichotomous *calyx* 0.5-0.7 cm, minutely puberulous outside. *Corolla* purple, puberulous outside, ca. 1.2 cm long, ventricose upwards. *Stamen* 2, inserted at the base of the upper lip, *Ovary* glandular-puberulous at the apex, ovules many, *Capsule* ca. 0.8-1 cm long, flattened, pubescent, *Seeds* 32-seeded.

Thailand.— NORTHERN: Chiang Mai, Nakhon Sawan, Tak; NORTH-EASTERN: Phetchabun, Kalasin, Mukdahan, Khon Kaen; EASTERN: Nakhon Ratchasima, Ubon Ratchathani; SOUTH-WESTERN: Uthai, Kanchanaburi, Ratchaburi Prachuap kiri khan; CENTRAL: Lop Buri, Ang Thong, Phra Nakhon Si Ayutthaya, Saraburi, Thonburi, Samut Prakan; PENINSULAR: Chumphon, Phatthalung.

Distribution.— Philippines.

Ecology.— Growing in gravel bed of stream.

Vernacular.— สาบแร้ง (Sab Rang) (Ang Thong).

3. **Hygrophila erecta** (Burm. f.) Hochr., Candollea 5: 230. 1934.— *H. phlomoides* Nees var. *roxburghi* C.B. Clarke.— *Ruellia erecta* Burm. f., Fl. Ind., 135. f. 3, pl. 41. 1768.

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Herb, perennials, ca.10-80 cm high, stems erect or decumbent at base, quadrangular, slightly pubescent. Leaves petiolate, blades ca. 2-8 by 1-2.5 cm, elliptic, obovate or oblong, base attenuate and decurrent onto petiole, apex acute, margin entire or slightly undulate, lateral nerves 8-12 pairs, both surface with numerous cystoliths, densely strigose; petioles sulcate, ca.0.3-0.6 cm long, hispid. Inflorescence flowers several clustered, axillary, sessile, bracteoles linear-oblong, densely hairy. Calyx 5-lobed, ca.0.6 cm, lobes linear-lanceolate, densely white hispid-ciliate. Corolla whitish to purple, ca. 1.5–2.5 cm, glabrous, limb 2-liped, lower lip obovate, 3-lobed to middle, lobes ovate with an obtuse apex, upper lip elliptic, shallowly 2-lobed, outside puberulent. Stamen 4, didynamous, filaments glabrous. Ovary glabrous, style pilose. Capsule narrowly oblong, 1–2 cm, glabrous. Seeds 12–18-seeded.

Thailand.— NORTHERN: Chiang Rai; SOUTH-WESTERN: Prachuap kiri khan; CENTRAL: Ang Thong, Saraburi, Bangkok; SOUTH-EASTERN: Chon Buri, PENINSULAR: Chumphon.

Distribution.— India, China, Myanmar, Laos, Vietnam and Suriname.

Ecology.— Open, disturbed roadside ditch, edge the rice field.

Vernacular.— ต้อยติ่ง (Toi ting), ต้อยติ่งไทย (Toi ting thai), ต้อยติ่งนา (Toi ting na) (Bangkok); น้ำดับไฟ (Nam dap fai) (Prachuap Khiri Khan).

4. **Hygrophila phlomoides** Nees, Pl. Asiat. Rar. (Wallich). 3: 80. 1832.— *Dipteracanthus ciliatus* Nee, Numer. List [Wallich] n. 7151. 1832.— *Ruellia phlomoides* Wall., Numer. List [Wallich] n. 2376. 1830.— *R. hirsuta* Roxb., Hort. Bengal. [95]; Fl. Ind. 3: 51. 1832.

Herb, annual or perennials, ca. 1 m high, erect. Stems quadrangular, brown strigose. *Leaves* sessile or subsessile, blades ca. 2–9 by 1–3 cm, elliptic, obovate, or oblong, base attenuate and decurrent onto petiole, apex acute, margin entire, lateral nevess 8–15 pairs, papery, densely cystoliths, both surfaces hirsute. *Inflorescence* flower in axillary sub-sessile clusters, 4-8 together, densely white-hairy, bracts small

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than calyx.*Calyx* densely white-hairy, united below the middle. *Corolla* whitish to purple, limb deeply bilabiate. *Stamen* 4, didynamous, inserted in the throat of the corolla, anther macronate at the base. *Ovary* bilocular, 8-many ovuled, style s-lobbed at the apex. *Capsule* linear or narrow oblong. *Seeds* many.

Thailand.— NORTH-EASTERN: Loei, Khon Kaen; EASTERN: Nakhon Ratchasima, Saraburi; SOUTH-EASTERN: Sa Kaeo, Chon Buri, Chathaburi, Trat; PENINSULAR: Chumphon, Satun, Pattani, Narathiwat.

Distribution.— Pakistan, China, India, Indonesia, Indo-China and Philippines.

Ecology.— Open, disturbed roadside ditch, edge the rice field.

Vernacular.— ซำ ซำ (Sam Sam) (Loei).

5. **Hygrophila polysperma** (Roxb.) T. Anderson, J. Linn. Soc., Bot.9: 456. 1867.— *Adenosma polysperma* (Roxb.) Spreng. Syst. Veg. (ed. 16) [Sprengel] 2: 829. 1825 *Basionym*: *J.polysperma* Roxb.— *Hemiadelphis polysperma* (Roxb.) Nees, Pl. Asiat. Rar.3: 80. 1832.— *Justicia polysperma* Roxb. Fl. Ind., ed.1: 120. 1820.

Herb, annual or perennials, ca. 10-20 m high, erect or prostrate at the base, stem quadrangular, young part softly white-hairy. *Leaves* petiolate, blades ca. 2-3 by 0.5-1.2 cm, oblong-lanceolate, glabrous, base attenuate, apex obtuse, margin entire, lateral nevess 5–8 pairs; petioles 0.5 cm long. glabrous. *Inflorescence* axillary, terminal cymes, bracts ovate, elliptic, or obovate, ca. 0.5–1 by 0.2–0.4 cm, both surfaces densely hirtellous, apex obtuse, bracteoles lanceolate, ca. 0.3-0.5 cm, margin ciliate. *Calyx* 5-lobed, ca.3.5–6 cm, lobes lanceolate, ca.0.2–0.3 cm, unequal, pubescent, apex acuminate. *Corolla* white, ca. 0.6-0.8 cm, lower lip ca. 0.2 cm, 3 lobed, lobesorbicular and subequal, upper lip oblong-ovate, ca. 0.1 cm, 2-lobed. *Stamen* 2, staminodes 2, slightly exserted, filaments ca. 1 cm. *Ovary* glabescent. *Capsule* linear-oblong, 0.5-0.8 cm long.

Thailand.— NORTHERN: Chiang Rai.

Ecology.— Opened, disturbed roadsides ditch.

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6. **Hygrophila ringens** (L.) R. Br. ex Spreng. var. **ringens**, Syst. Veg.2: 828. 1825.— *Dipteracanthus ringens* (L.) Abeyw., Ceylon J. Sci., Biol. Sci. 2(1): 84. 1959.— *Hygrophila ringens* (L.) Steud.Nomencl. Bot. [Steudel], ed. 2. 1: 783. 1840.— *H. angustifolia* R.Br., Prodr. Fl. Nov. Holland. 479. 1810.—*H. incana* Nees, Prodr. [A. P. de Candolle] 11: 91. 1847.— *H. intermedia* J.B. Imlay; Bull. Misc. Inform. Kew 111. 1939.— *H. salicifolia* (Vahl) Nees; Pl. Asiat. Rar. (Wallich). 3: 81 Nomencl. Bot. (ed. 2)1: 783. 1840.— *H. lancea* (Thunb.) Miq., Ann. Mus. Bot. Lugduno-Batavi 2: 123.— *H. megalantha* Merr. Phil. Jour. Sci. 12(2): 110. 1917.— *H. quadrivalvis* (Buch.-Ham.) Nees, Pl. Asiat. Rar.3: 89. 1832.— *Justicia lancea* Thunb.Trans. Linn. Soc. London 2: 338. 1794.— *Ruellia quadrivalvis* Buch.-Ham. Trans. Linn. Soc. London14: 291. 1824. — *R. ringens* L.Sp. Pl. 2: 635. 1753.

Herb, annual or perennials, ca. 20-80 cm high, branched, stems erect or decumbent at base, quadrangular, slightly pubescent. *Leaves* petiolate, blades ca. 2-10 by 1-2.5 cm, lanceolate to oblanceolate, base attenuate and decurrent onto petiole, apex acute to obtuse, margin entire or slightly undulate, lateral nerves 7-10 pairs, both surface with numerous cystoliths, glabrous or slight pubescent; petioles ca. 0.5-1.5 cm long, pubescent. *Inflorescence* flowers solitary or 1-10 flowers in clusterd, axillary, sessile, *Calyx* narrowly campanulate, ca. 0.5 cm, 5-lobed to middle, lobes linear-lanceolate, grayish pubescent or fulvous strigose, apex acuminate. *Corolla* whitish to purple, 1–1.5 cm, glabrous, limb 2-liped, lower lip obovate, 3-lobed to middle, lobes ovate with an obtuse apex, upper lip elliptic, shallowly 2-lobed, outside puberulent. *Stamen* 4, filaments glabrous. *Pollen* heterogeneous, prolate (P) and prolate spheroidal (PS), P(P): 51.25±0.96, P(PS): 34.38±1.54, E(P): 34.38±1.45, E(PS): 33.75±1.20, P/E(P)=1.49, P/E(PS)= 1.01, 14-16 pseudocolpi, 16-18 ribs, ribs with reticulate tectum. (**Apendix Figure 24**) *Ovary* glabrous, style filiform. *Capsule* narrowly oblong, ca. 1 cm, glabrous. *Seeds* 12–18-seeded.

Thailand.— NORTHERN: Chiang Mai, Tak, Pitsanulok; SOUTH-WESTERN: Ratchaburi , Phetchaburi, Angtawng, Phra Nakhon Si Ayutthaya, Saraburi; CENTAL Bangkok; SOUTH-EASTERN: Prachinburi, Chanthaburi, Rayong; PENINSULAR: Chumphon, Krabi, Trang, Satun, Pattani, Narathiwat.

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Distribution.— Ceylon, Benga, Slangor, Pahang, Singapore, Annam and Cochinchina.

Ecology.— Open, disturbed roadside ditch, in edge the rice field.

Vernacular.— ไฟเดือนห้า (Fai duean ha) (Nakhon Ratchasima); หญ้าสาบกา (Ya sapka) (Ang Thong).

6. PHAULOPSIS

Willd., Sp. Pl. 3: 4, 342. 1800[1799], annotation: nom. et orth. cons. as "Phaylopsis", corr. Sprengel 1817.— *Micranthus* J. C. Wendl., Bot. Beob. 38. 1798.— *Phaylopsis* Willd., Sp. Pl. (ed.3) 342. 1800.— *Aetheilema* R. Br., Prodr. 478. 1810.— *Theileamea* Bail., Bull. Mens. Soc. Linn. Paris 821. 1890; type specimens: *Phaulopsis parviflora* Willd.

Herbs, annual or perennial, prostrateto erect, with cystoliths, often anisophyllous. *Leaves* petiolate, opposite, leaf blade margin entire or crenate. *Inflorescences* terminal or axillary, secund strobilate spikes, bracts leaf-like, orbicular or reniform, imbricate, bracteoles present or absent. Flowers sessile. *Calyx* 5-lobed almost to base, lobes unequal, posterior one largest. *Corolla* small, tube cylindric, slender, limb 2-lipped, lower lip 3-lobed, upper lip 2-lobed, lobes contorted in bud. *Stamens* 4, didynamous, included in corolla tube, filaments coherent at base, anthers 2-thecous, thecae parallel, base minutely mucronate. Ovary with 2 ovules per locule, style hairy, stigma 2-lobed, lobes unequal. *Capsule* shortly stipitate, 4-seeded, retinacula present, septa with attached retinacula separating from inner wall of mature capsule. *Seeds* discoid, densely covered with hygroscopic trichomes.

About twenty-two species from tropical Africa, E, SE, and S Asia. One species in Thailand.

Phaulopsis dorsiflora (Retz.) Santapau, Kew Bull. 1948: 276. 1948.— *R. dorsiflora* Retzius, Observ. Bot. 6: 31. 1791.— *M. oppositifolius* J.C. Wendl., Bot. Beob. 39. 1798.— *A. parviflorum* Spreng., Syst. Veg. 2: 826. 1825.— *A. reniforma* Nees, Pl. Asiat. Rar. 3: 94. 1832. — *Blechum anisophyllum* Juss., Ann. Mus. Hist. Nat. 9: 270. 1807.—

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Aetheilema anisophyllum (Juss.) E. Mey. ex Nees, Prodr. 11: 262. 1837.─ *Phaulopsis oppositifolia* (J.C. Wendl.) Lindau, Nat. Pflanzenfam. 1: 305. 1897. as "Phaylopsis"; *homonym.─ P. parviflora* Willd., Sp. Pl. 3: 342. 1800. (**Apendix Figure 3**B)

Herb, isophyllous, ca. 30–50 cm tall, Stems ascending, quadrangular, brown retrorsely pubescent. *Leaves* petiolate, blades ca. 7.5–11 by 3.5–5 cm, ovate to elliptic, base cuneate to attenuate and slightly oblique, apex acuminate, margin entire, lateral nerves 6-7 pairs, papery, abaxially pubescent along veins, adaxially hirsute; petioles 3–5 cm long, glabrous. *Inflorescence* terminal or axillary, secund strobilate spikes3–6 cm, bracts orbicular to reniform, ca. 1 by 1.4 cm, sticky, gland-tipped pubescent. *Calyx* lobes outside gland-tipped pubescent, posterior lobe ovate-elliptic, 0.8–1 cm, bractlike, other lobes linear to subulate. *Corolla* white, ca. 0.5-0.8 cm, lower lip 3-lobed, lobes ovate-oblong and 0.2–0.4 by 0.1-0.2 cm, upper lip narrow, 2-lobed. *Stamen* 4, glabrous. *Pollen* prolate, 3-colporate, P=31.53±1.05, E=15.93±0.51, P/E=1.97, 16-18 pseudocolpi, 18-20 ribs, ribs withcoarsely reticulate tectum. (**Apendix Figure 25**) *Ovary* apex sparsely gland-tipped pubescent, style pilose. *Capsule* ellipsoid, ca. 0.4-0.5 cm, apex gland-tipped pubescent. *Seeds* 4-seeded.

Thailand.— NORTHERN: Mae Hong Son, Chiengmai, Chiengrai, Phayao, Nan, Lamphun, Lampang, Sukhothai, Phitsanulok; EASTERN: Chaiyaphum, Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi, Prachuap kiri khan; CENTRAL: Bangkok; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Yala.

Distibution.— China, India, Bangladesh, Bhutan Vietnam, Madagascar, Reunion, and South Africa

Ecology.— Opened, roadsides.

Vernacular.— น้ำมอกบ่อวาย (Nam mok bo wai) (Nakhon Ratchasima)

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7. RUELLIA

L., Sp. Pl. 2: 634. 1753.— *Blechum* P. Browne, Civ. Nat. Hist. Jamaica. 261. 1756. — *Dipteracanthus* Nees, Pl. Asiat. Rar. 3: 75. 81-82. 1832.— *Aphragmia* Nees, Nat. Syst. Bot. 444. 1836.— *Eusiphon* Benoist, Notul. Syst. (Paris) 8: 144. 1939.— *Cryphiacanthus* Nees, Index Sem. Horti Vratisl. 1841.— *Pseudoruellia* Benoist, Bull. Soc. Bot. France 109: 131. 1962.— *Benoicanthus* Heine & A. Raynal, Adansonia, n. s. 8: 190-191. 1968; *Blechum* and *Dipteracanthus* are included in Ruellia based on morphological and molecular data (C. Ezcurra, Ann. Missouri Bot. Gard. 80: 787–845. 1993; E. Tripp, Syst. Bot. 32: 628–649. 2007; E. Tripp et al., Taxon 58: 893–906. 2009; Type specimens: *Ruellia tuberosa* L., LT designated by N. L. Britton et A. Brown, 52. Fl.N.U.S. ed. 2. 3: 241. 1913.

Herbs, perennials, prostrate to erect, with cystoliths. *Leaves* sessile or petiolate, leaf blade margin entire, crenulate, or dentate. *Inflorescences* axillary or terminal, reduced or expanded dichasia, sometimes forming dichasiate spikes, thyrses, or panicles, sometimes reduced to a solitary flower, bracts opposite, usually green, margin entire, bracteoles 2 or absent. Flowers sessile or subsessile to pedicellate. *Calyx* deeply 5-lobed, lobes equal or subequal. *Corolla* funnel-shaped,tube basally with a narrowly cylindric portion, usually expanded apically into a distinct throat; limb 5-lobed, lobes usually ovate to orbicular, equal to unequal in size, contorted in bud. *Stamens* 4, didynamous, usually included in corolla tube; filaments sometimes connate in pairs at base; anthers 2-thecous, thecae equal, parallel to subsagittate, muticous at base, staminode 1 or absent. *Ovary* with up to 10 ovules per locule, style usually included in corolla tube or slightly exserted, stigma 2-lobed, lobes equal or unequal. *Capsule* stipitate or not stipitate, 12–26-seeded, retinacula present, septa with attached retinacula remaining attached (or separating in *Ruellia blechum*) to inner wall of mature capsule. *Seeds* discoid, usually pubescent with hygroscopic trichomes.

About 250 species: tropical to temperate regions worldwide, eight species in Thailand.

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KEY TO SPECIES

1. septa with retinacula separating from inner wall of mature capsule; Flowers in terminal dense 4-sided spikes.....**2**. **R. blechum**

1. septa with retinacula remaining attached to inner wall of mature capsule;……
Flowers otherwise. ……..……..…….(2)

2. Creeping herbs; corolla whitish, 1.2–2 cm .....**6**. **R. repens**

2. Erect herbs; corolla purplish, 2.2–5.5 cm……(3)

3. Corolla at least 5 cm long…….……..……**3**. **K. kerrii**

3. Corolla at most 5 cm long…….……..(4)

4. Bracteoles spathulate… ……..……..…**5**. **R. patula**

4. Bracteoles not spatulate……..…….(5)

5. Roots with tuberlike swellings; flowers pedicellate ..... **7**. **R. tuberosa**

5. Roots lacking tuberlike swellings; flowers sessile .....(6)

6.. Leaves oblong-lanceolate, close together ..……...……..**1**. **R. bella**

6. Leaves linear-lanceolate, …..……..……..…..... (7)

7..Leaves glabrous……...……...…….**8**. **R. simplex**

7. Leaves hairy on both surfaces……...……..…**4**. **R. macrosiphon**

1. **Ruellia bella** Craib, Bull. Misc. Inform. Kew 1918: 366. 1918.

Herb, almost acaulous or stemless. *Leaves* close together, blades ca. 5-7 by1.5-3 cm, oblong, oblong-elliptic, or oblong-lanceolate, base cuneate, apex obtuse , magin densely ciliate with white hairy, lateral nerves 4-6 pairs, conspicuous, sparsely villous on both surface; petioles ca. 0.5-1 cm long, pubescent. *Inflorescence* flower axillary or in pairs. *Calyx* ca. 0.5 cm long, sparsely white-hairy. *Corolla* white, opening at night, white-pubescent outside, ca. 4.5-5 cm long, becoming funnel-shaped. *Stamen* inserted at the base of the expanded part of the corolla tube, glabrous. *Ovary* very sparsely pubescent at the apex, style ca. 4 cm long, hairy.*Capsule* ca. 2 cm long, glabrous, with a short sterile stalk. *Seeds* 10-12 seeded, orbicular, flattened, with thickened margin, densely ciliate.

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Thailand.— NORTHERN: Lampang; NORTH-EASTERN: Loei; SOUTH-WESTERN: Kanchanaburi, Ratburi.

Ecology.— Flowers white, opening at night, in deciduous forest.

Conservation Status.— Rare (by author).

2. **Ruellia blechum** L. Syst. Nat. (ed.10) 2: 1120. 1759.─ *Barleria pyramidata* Lam., Encycl. 1: 380–381. 1785.─ *Blechum brownei* Juss., Ann. Mus. Natl. Hist. Nat. 9: 270. 1807.─ *Blechum linnaei* var. *laxum* Nees, Prodr. 11: 466. 1847.─ *Ruellia parviflora* Sessé & Moc., Fl. Mexic. 147. 1894.─ *Blechum blechum* (L.) Millsp., Publ. Field Columb. Mus., Bot. Ser. 2(1): 100. 1900.─ *Blechum pyramidatum* (Lam.) Urb., Repert. Spec. Nov. Regni Veg. 15: 323. 1918.─ *Blechum brownei* of. *puberulum* Leonard, J. Wash. Acad. Sci. 32(6): 184. 1942. ─ *Blechum brownei* of. *brownie*, Monogr. Syst. Bot. Missouri Bot. Gard. 45: i–xl, 1–1286. 1993.

Herb, annual, ca. 10-30 cm high, stems slightly quadrangular, often prostrate and rooting at nodes, sparsely pubescent to subglabrous. *Leaves* petiolate, blade ca. 3–6 by 2–4 cm, ovate, base obtuse to rounded and slightly decurrent onto petiole, apex acute, margin entire, lateral nerves 5–8 pairs, abaxially paler and subglabrous, adaxially green, sparsely strigose and densely pilose along veins; petioles ca. 0.5–2.5 cm long. *Inflorescence* terminal dense 4-sided spikes, 5-10 cm long, subsessile to shortly pedunculate, rachis strigose, bracts subleaflike, ovate, ca. 1.5 by 1.3 cm, abaxially slightly pubescent, margin ciliate, bracteoles 2, lanceolate-ovate,ca. 0.5–1 by 0.2–0.3 cm, margin ciliate. *Calyx* lobes linear to subulate, out-side pilose. *Corolla* white to pale blue, ca. 1.5 cm, outside puberulent on lobes. lobes ovate. *Stamen* 4, didynamous, filament glabrous. *Pollen* subprolate, 3-colpate, P=44.44 ±0.53, E=36.11±0.67, P/E=1.23, coarsely reticulate tectum. (**Apendix Figure 26**) *Ovary* 2-locules, style ca. 0.5–1 cm long, slightly hirsute. *Capsule* substipitate, ovoid to ellipsoid, ca. 0.5 cm, puberulent, septa with attached retinacula separating from inner wall of mature capsule. *Seeds* 8–12-seeded.

Thailand.— NORTHERN: Nan.

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Distibution. — Belize, Caribbean Haiti, Jamaica, Dominica, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guyana, Honduras and Mexico.

Ecology.— Roadsides, opened area.

3. **Ruellia kerrii** Craib, Bull. Misc. Inform. Kew 1913: 202. 1913.— *R. subulata* J.B. Imlay, Bull. Misc. Inform. Kew 1939: 112. 1939.— *R. siamensis* J.B. Imlay, Bull. Misc. Inform. Kew, 1939: 114. 1939. (**Apendix Figure 3**C)

Herb, isophyllous, ca. 20-50 cm high, prostrate, stem with spreading hairy, becoming more or less glabrous. *Leaves* petiolate, blades 5-12 by 2.5-5 cm, lanceolate, or ovate-lanceolate, base cuneate, apex acuminate to acute, margin entire, lateral nerves 5–7 pairs, chartaceous, sparsely whitish-hairy above and on the nerves below; petioles 2-2.5 cm long. *Inflorescence* flowers axillary, solitary, sessile, bracteoles spathulate. *Calyx* 5-lobed, ca. 1.5 cm long, hairy. *Corolla* purple, 5-6 cm long, tube narrow at the base ca. 1.2 cm, venticose upward, lobes subequal ca. 1.2-1.5 cm, retuse. *Stamen* inserted at the base of the expanded part of corolla tube, filaments glabrous. *Pollen* prolate spheroidal, 3-porate, P=74.40±0.95, E=68.00±0.86, P/E=1.09, less open reticulate tectum, with occasional small granules of exine in lumina. (**Apendix Figure 27**) *Ovary* glabrous, style 3-4 cm long, hairy. *Capsule* 1.5-1.8 cm long, glabrous. *Seeds* 8-16 seeded.

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai, Lamphun, Lampang, Tak, Kamphaeng Phet; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Uthai Thani, Kanchanaburi; CENTRAL: Suphan Buri.

Ecology.— In evergreen forest.

Conservation Status.— Vulnerable (by author).

4. **Ruellia macrosiphon** Kurz**,** J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42(2): 92. 1873.

Herb, isophyllous, perennials, ca. 10-20 cm high, erect, slender, stem subquadrangular, hairy. *Leaves* sessile or subsessile, blades ca. 5-12 by 0.5-1 cm, linear, oblong or linear-lanceolate, base cuneate, apex acuminate to acute, margin

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entire, lateral nerves 6–8 pairs, chartaceous, hairy with longish white hairs bothside. *Inflorescence* flowers axillary, solitary, sessile, bracteoles leaflike. *Calyx* 5-lobed, ca. 0.8 cm long, puberulous, unit at the base. *Corolla* purple, ca. 5-6 cm long, tube narrow at the base ca. 1.2 cm, venticose upward, lobes subequal ca. 1.2-1.5 cm, retuse. *Stamen* inserted at the base of the expanded part of corolla tube, filaments glabrous. *Ovary* pubescent, style ca. 3-4 cm long, pubescent. *Capsule* ca. 1.5 cm long, glabrous. *Seeds* 8-16 seeded.

Thailand.— NORTHERN: Chiang Mai, Lampang; SOUTH-WESTERN: Kanchanaburi.

Distribution.— Myanmar.

Ecology.— In evergreen forest.

5. **Ruellia patula** Jacq., Misc. Austriac. [Jacquin] 2: 358–359. 1781.

Herb, isophyllous, annual, ca. 20-50 cm high, procumbent, stem terete, densely pubescent, sometimes with a few glandular hairs. *Leaves* petiolate, blades ca. 2-4.5 by 2-2.5 cm, ovate, or elliptic, base acute, apex acute, margin entire, lateral nerves 4–6 pairs, chartaceous, sparsely hairy with longish whitish-hairy on bothsurface, petiole ca. 0.5-1 cm long. *Inflorescence* flowers axillary, solitary, sessile, bracteoles oblong-elliptic, ca. 1.5 cm long. *Calyx* ca. 1.5 cm long, short pubescent. *Corolla* whitish or pale pink, opening at the night times, ca. 2.5-5 cm long, tube narrow at the base, venticose upward, lobes subequal, rounded. *Stamen* inserted at the base of the expanded part of corolla tube, filaments glabrous. *Ovary* puberulous, style ca.2-3 cm long. *Capsule* ca. 1.5 cm long, globose-clavate, acute, puberulous. *Seeds* 6-seeded.

Thailand.— NORTHERN:Lampang, Tak; NORTH-EASTERN: Phetchabun; SOUTH-WESTERN: Kanchanaburi.

Distribution.— India, Myanmar, Madagascar and South Africa.

Ecology.— In evergreen forest.

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6. **Ruellia repens** L. Mant. Pl. 1: 89. 1767.— *Dipteracanthus lanceolatus* Nees, Pl. Asiat. Rar. (Wallich). 3: 82. 1832.— *D. repens* (L.) Hassk., Hoev. & De vriese, Tijdschr. 10: 129. 1843.— *R. dissimilis* J.B. Imlay, Bull. Misc. Inform. Kew. 1939: 112. 1939.—*R. hirtella* J.B. Imlay, Bull. Misc. Inform. Kew. 1939: 113. 1939; *Homonyms*: *R. repens* Ruiz ex Nees,Prodr. Sys. Nat. Reg. Veg. 11: 109. 1847. (**Figure 2; Apendix Figure 3**D)

Herb, isophyllous, annual or perennials, ca. 5–30 cm high, creeping, stems quadrangular, finely pubescent or glabrescent. *Leaves* petiolate, blades ca. 1.5–3.5 by 1–2 cm, ovate to linear-lanceolate, base broadly cuneate to rounded, apex acuminate to acute, margin subentire, lateral nerves 4-5 pairs, both surfaces sparsely strigose; petiole ca.0.2–0.5 cm long. *Inflorescence* Flowers axillary, solitary, bracteoles sub-leaflike, ovate to ovate-oblong, ca. 0.5–1 cm. *Calyx* lobes lanceolate, ca. 0.5 cm, margin sparingly ciliate. *Corolla* whitish pink to light purple, ca. 2-2.5 cm long, outside pilose, tube ca. 0.5-1 cm, ventricose upward, lobes ovate, apex obtuse. *Stamen* 4, didynamous, ca. 0.2-0.5 cm, filaments glabrous, anther thecae ca. 0.1 cm. *Ovary* comose, style ca. 1 cm, hirsute, stigma lobes unequal. *Capsule* brownish yellow, stipitate, ca. 1.2 cm, slightly pilose. *Seeds* 8-12 seeded.

Thailand.— NORTHERN: Mae Hong Son, Lamphun, Lampang, Tak, Nakhon Sawan; NORTH-EASTERN: Loei, Mukdahan; EASTERN: Nakhon Ratchasima, Ubon Ratchathani; SOUTH-WESTERN: Kanchanaburi, Prachuap kiri khan; CENTRAL: Saraburi, Bangkok; PENINSULAR: Chumphon, Surat Thani, Krabi, Nakhon Si Thammarat, Phatthalung, Satun, Songkhla, Pattani, Yala.

Distribution.— China, Myanmar, Vietnam, Malaysia, Indonesia and Papua New Guinea.

Ecology.— Opened, disturbed area, roadsides.

Vernacular.—จ้าหอม (Cha hom), ฟ้าแมง (Fa maeng) (Nakhon Ratchasima); ต้อยติ่งเลื้อย (Toi ting lueai) (General).

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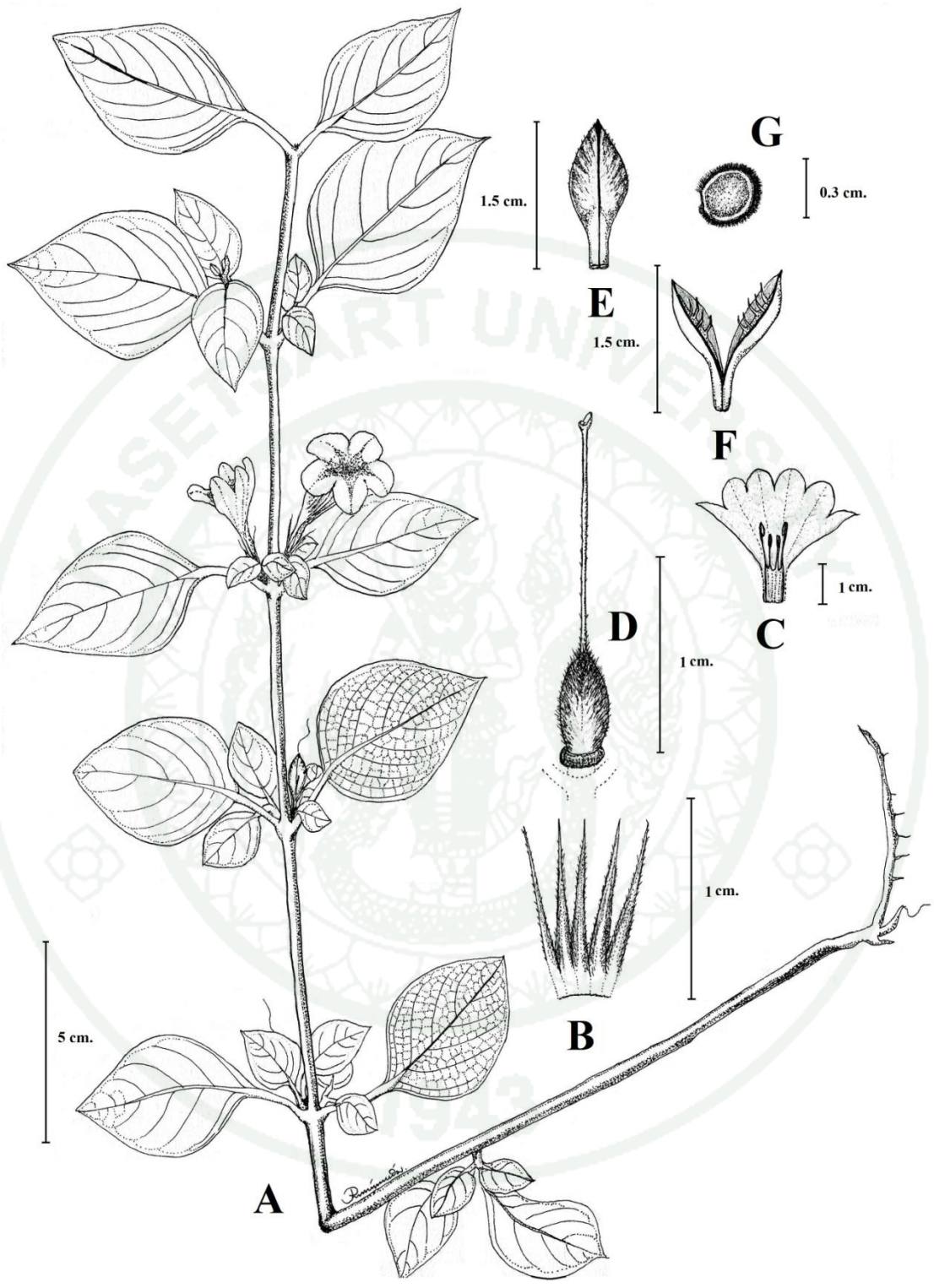

Figure 2 *R. repens* L.: A. habit; B. calyx; C. longtitudinal section of flower; D. pistil; E-F. capsule dehiscence; F. seed; Drawn by Panarat Charoenchai.

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7. **Ruellia simplex** C. Wright, Anales Acad. Ci. Med. Habana. 6(41):321. 1870.— *R. microphylla* Cav.[Illegitimate], Icon. 6: 63. 1801.— *Arrhostoxylum microphyllum* Nees, Fl. Bras. 9: 61. 1847.—*Cryphiacanthus angustifolius* Nees, Prodr. 11: 199. 1847.— *Dipteracanthus spectabilis* Hook., Bot. Mag. 76: t. 4494 1850. —*R. tweediana* Griseb. [Illegitimate], Abh. Königl. Ges. Wiss. Göttingen. 24: 259. 1879.— *R. spectabilis* (Hook.) G. Nicholson[Illegitimate], Ill. Dict. Gard. 334. 1886.— *R. coerulea* Morong, Ann. New York Acad. Sci. 7(2): 193. 1892. — *R. brittoniana* Leonard [Illegitimate], J. Wash. Acad. Sci. 31(3): 96. 1941. — *Ruellia angustifolia* (Nees) Lindau, Nat. Pflanzenfam. 4(3b): 311. 1895. — *R. malacosperma* Greenm., Proc. Amer. Acad. Arts 34: 572 1899.— *R. longipes* Urb., Symb. Antill. 9: 129. 1923.— *R. ignorantiae* Herter, Revista Sudamer. Bot. 4: 193. 1937. (**Apendix Figure 4A**)

Herb, isophyllous, perennials, ca. 10-50 cm high, erect, stems slightly swollen above nodes, almost quadrangular, *Leaves* petiolate, blades ca. 3–11 by 1-1.5 cm, lanceolate to linear, base cuneate and tapering onto petiole, apex acute, margin undulate to subentire, lateral nerves 7-8 pairs, both surfaces glabrous, veins abaxially somewhat prominent; petioles ca.0.5-1 cm long, glabrous. *Inflorescence* axillary, lax dichotomous cymes, peduncle to 2 cm, bracts oblong-lanceolate, bracteoles linear-oblong. *Calyx* 5-lobed, ca. 1-1.4 cm, outside glabrous, lobes linear-lanceolate. *Corolla* purple and pink, ca. 3.5–4 cm long, lobes suborbicular, ca. 1.5 cm. *Stamen* 4, didynamous, with longer pair ca. 1cm and shorter pair ca. 0.5 cm, filaments glabrous, anther thecae white, hairy on dorsal side. *Ovary* glabrous except for a few gland-tipped trichomes at apex, style ca. 2 cm. *Capsule* oblong, ca. 1.5–2.5 by 0.2–0.5 cm, glabrous. *Seeds* 20-24–seeded, discoid, ca. 0.5 cm, covered with appressed hygroscopic trichomes.

Thailand.— CENTRAL: Saraburi, Bangkok.

Distribution.— Argentina, Brazil, Paraqua and Uruqua.

Ecology.— Cultivated plants.

Vernacular.— ต้อยติ่งเทศ (Toi ting Tat) (Bangkok).

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8. Ruellia tuberosa L., Species Plantarum 2: 635. 1753. (**Apendix Figure 4B**)

Herb, isophyllous, perennials, ca. 10-50 cm tall, erect, roots with elongate tuberlike swellings, stems slightly swollen above nodes, almost quadrangular, strigulose on angles. *Leaves* petiolate, blades ca. 4–8 by 1.5–5 cm, oblong-obovate, base cuneate and tapering onto petiole, apex acute, margin undulate to subentire, lateral nerves 4-5 pairs, glabrous, veins abaxially somewhat prominent; petioles ca. 0.5-1 cm long, glabrous. *Inflorescence* axillary, lax dichotomous cymes, peduncle to 2 cm, bracts oblong-lanceolate, bracteoles linear-oblong. *Calyx* 5-lobed, ca. 0.8 mm, outside tomentose, lobes linear-lanceolate. *Corolla* purple, pink rarely white, ca. 2.5–5 cm long, lobes suborbicular, ca. 1.5 cm. *Stamen* 4, didynamous, with longer pair ca. 8 mm and shorter pair ca. 0.5 cm, filaments glabrous, anther thecae white, hairy on dorsal side. *Pollen* prolate spheroidal, 3-porate, P=52.63±0.50, 51.58±0.49, P/E=1.02, less open reticulate tectum, with occasional small granules of exine in lumina(**Apendix Figure 28**) *Ovary* glabrous except for a few gland-tipped trichomes at apex, style ca. 2.1 cm, sparsely hirsute, stigma 2-lamellate. *Capsule* clavate, linear-ellipsoid, ca. 1.5–2.5 cm long, glabrous except for a few gland-tipped trichomes at apex septa with attached retinacula remaining attached to inner wall of mature capsule calvate, oblong. *Seeds* 8-18-seeded, discoid, ca. 0.2 cm, covered with appressed hygroscopic trichomes.

Thailand.— NORTHERN: Chiang Mai, Lampang, Phitsanulok; SOUTH-WESTERN: kanchanaburi; CENTRAL: Ayutthaya, Saraburi, Bangkok, Samut Prakan, Samut Sakhon; SOUTH-EASTERN: Chon Buri; PENINSULAR: Songkhla, Phatthalung.

Distribution— Argentina, Bolivia, Caribbean, Colombia, El Salvador, French Guiana, Guatemala Izabal, Guyana, Honduras, Panama, Peru, United Stated, Venezuela.

Ecology.— Opened, disturbed area, roadsides.

Vernacular.— ต้อยติ่ง (Toi ting) (Bangkok).

Note.— *R. tuberosa* is widely naturalized in tropical areas.

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8. SANCHEZIA

Ruiz & Pav., Fl. Peruv. Prodr. 5, t. 32. 1794.— *Ancylogyne* Nees, in Mart. Fl. Bras. ix. 63. t. 7. 1847; type specimens: *Sanchezia oblong*a Ruiz & Pav. LT designated by Bremekamp, Index Nom. Gen. Card 01984. 1956.

Shrubs or perennial herbs, with cystoliths. *Leaves* coriaceous, blade margin entire or obscurely crenate. *Inflorescences* thyrses or rarely axillary cymes or racemes, bracteoles 2, small. *Calyx* deeply 5-lobed, lobes usually covered with gland-tipped trichomes. *Corolla* orange, cylindrical-shaped and abruptly inflated lobes, Stamens 2, didynamous, anthers 2-thecous, thecae parallel, equal, hirsute, muticous at base, staminodes 2. *Ovary* ovoid, long hirsute, style filiform, stigma 2-cleft. *Capsule* cylindric, 8–12-seeded, retinacula present. *Seeds* ovate, compressed, tomentose.

Native plant from Brazil, Colombia and Hoduras, only one species are cultivated in Thailand.

Sanchezia oblonga Ruiz & Pav., Fl. Peruviana, et Chilensis Prodr. 1: 7, pl. 8, f. b. 1798.─ *S. hirsuta* Pers., Syn. Pl. 1: 24. 1805.─ *Ancylogyne peruviana* DC., Prodr. 11: 222. 1847.─ *S. nobilis* Hook., Bot. Mag. 92: t. 5594. 1866.─ *S. peruviana* (Nees) Rusby, Mem. Torrey Bot Club 6: 103. 1896.─ *S. helophila* Leonard & L.B. Sm., Rhodora 66(768): 325, f. 2A–B. 1964.─ *S. macbridei* Leonard, J. Wash. Acad. Sci. 16: 487. 1926. (**Apendix Figure 4C**)

Shrub, cultivated, ca. 2-3 m high, branched. *Leaves* petiolate, blades ca. 5-25 by 3-10 cm, oblong-lanceolate, base attenuate with winged connate at the base, apex acuminate to acute, margin entire, lateral nerves 10-15 pair, coriaceous, glabous; petioles 1-3 cm long. *Inflorescence* terminal, erect, thyrses, ca. 5-15 cm long, bracts 2-2.5 cm long, ovate or obovate, obtuse, concave, glabous, enclosing several flowers, bracteoles 2, shorter than calyx, oblong obtuse 1-1.5 by 0.2-0.5 cm, glabrous. *Calyx* glabrous, ca. 2-2.5 by 0.2-0.5 cm. *Corolla* orange or yellowish red, ca. 5-6 cm long, pubescent outside, tubular or cylindrical, straight tube, contacted at the mount, lobes 5 subequal, obtuse, revolute. *Stamen* 4, 2 fertiles, exserted, longer than corolla lobes, 3-5 cm long, 2 steriles, shorter than corolla tube, 1-2 cm long, filaments ca. 6-7 cm long, hairy, anther unequal, oblong, shortly spurred at the base. *Pollen* oblate

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spheroidal, 2-colpate, P=84.62±10.91, E=44.25±6.25, P/E=0.98, 20-24 ribs, coarsely bireticulate tectum. (**Apendix Figure 29**) *Ovary* glbrous, style 5-6 cm long, galbrous, stigma curved. *Capsule* 8-12 seeds.

Thailand.— Songkla.

Distribution.— Brazil and Ecuador.

Ecology.— Cultvated plants for hence.

Vernacular.— เอื้องทอง (Ueag Thong) กนกลายไทย (Kanok Lai Thai) (Bangkok).

Note.— A native of Ecuador, popular cultivated in other part of the world.

9. STROBILANTHES

Blume, Bijdr. Fl. Ned. Ind.14: 781, 796. 1826.— *Lepidagathis* sect. *Apolepsis* Blume, Bijdr. Fl. Ned. Ind. (14): 802. 1826.— *Adenacanthus* Nees in Wall. Pl. As. Rar. 3. 75,196. 1832; —*Aechmanthera* Nees, Pl. Asiat. Rar. 3: 75, 87. 1832; —*Goldfussia* Nees, Pl. Asiat. Rar. 3: 75, 87. 1832; —*Strobilanthe*s subg. *pteracanthus* Nees, Pl. Asiat. Rar. 3: 87. 1832.— *Strobilanthes* subg. *Sympagis* Nees, Pl. Asiat. Rar. 3:87. 1832.— *Apolepsis* (Blume) Haassk., Cat. Hort. Bot. Bogor. 150. 1844.— *Hemigraphis* Nees, Prodr. Syst. Nat. Reg. Veg. 11: 722-723. 1847.— *Gutzlaffia* Hance, Hooker's J. Bot. Kew Gard. Misc. 1: 142. 1849; —*Pseudostenosiphonium* Lindau, Bot. Jahrb. Syst. 18: 52. 1893.— *Championella* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41(1): 150. 1944.— *Parachampionella* Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 151. 1944.— *Sericocalyx* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 157. 1944; —*Pseudaechmanthera* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 188. 1944.— *Baphicacanthus* Bremekamp, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41(1): 190. 1944.— *Perilepta* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41(1): 193. 1944— *Pteracanthus* (Nees) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 198. 1944.— *Semnostachya* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 201. 1944— *Pyrrothrix*

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Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 209. 1944.— *Tetraglochidium* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 214. 1944.— *Diflugossa* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41(1): 235. 1944.— *Sympagis* (Nees) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 254. 1944; —*Tetragoga* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 299. 1944.— *Hymenochlaena* Bremekamp, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 301. 1944— *Pteroptychia* Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 303. 1944; —*Paragutzlaffia* H. P. Cui. Acta Bot. Yunnan. 12(3):273. 1990; type specimen: *Strobilanthes cernua* Blume, LT designated by Bremekamp, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuuk., Tweede Sect. 41(1): 39. 1944.

Herbs, subshrubs, shrubs, isophyllous or slightly to strongy anisophyllous, woody species commonly monocarpic or plietesial (living for several years then dying after flowering and fruiting). Stems and branches usually quadrangular, often sulcate, basally becoming woody. *Leaves* opposite, petiolate or sessile, leaf blade adaxially usually with prominent linear cystoliths and sometimes also abaxially, margin variously dentate, serrate, crenate, undulate, or entire. *Inflorescences* axillary, terminal, bracteate heads, headlike clusters, spikes, panicle, bracts present in compound inflorescences, persistent or caducous as flowers open, very variable in size and shape, bracteoles 2 per pedicel, usually small, sometimes absent. *Calyx* usually 5-lobed to base, commonly accrescent in fruit, lobes equal or with middle one distinctly longer than others, sometimes partially fused to form a bipartite or tripartite calyx. *Corolla* purple, bluish, white, yellow or pink, tubular or funnel-shaped, inside glabrous apart from trichomes retaining style, tube either gradually widened from base or narrowly cylindric and then abruptly widened, ventricose or campanulate, limb 5-lobed, lobes usually ovate, equal or subequal, spreading, contorted in bud. *Stamens* (2-)4 and didynamous, basally monadelphous, usually 2 filaments distinctly longer than other 2, anthers inserted or exserted, 2-thecous, thecae oblong or subspherical, parallel, erect or incurved, glabrous, basally muticous, rarely with connective extended to a mucronate tip. *Ovary* oblong to obovoid, 2-locular, with 2(–

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8) ovules per locule, style filiform, long, slender, two rows of hairs or trichomes sustaining the style, stigma 2-cleft with one branch longer. *Capsule* oblong to narrowly obovoid, (2–)4(–16)-seeded, retinacula strong, curved. *Seeds* usually ovate or orbicular, lenticular, usually pubescent with appressed mucilaginous trichomes which become spreading when wetted.

About 250 species: tropical to temperate regions worldwide 50 species in Thailand.

KEY TO SPECIES

1. Hydrophilous or Aquatic Plant.....**50.Hemigraphis repanda**
1. Terrestial Plant.....2
2. Treelet, stem ca. 12 cm in diameter……**8. S. bilabiata**
2. Herbs, shrubs or subshrubs 3
3. Ovules 3-12 per locule.....4
3. Ovules 2 per locule.....10
4. Flowers in clustered 1-3, or solitary. ……..……..……**28. S. hispidula**
4. Flowers in densely bracteate spikes.....5
5. Corolla less than 2 cm long.....6
5. Corolla 2-5 cm long.....8
6. Leaves attenuate at base, not purple, bracts with grandular hairs…….**12. S. confinis**
6. Leaves rounded or cordate at the base, purple ……..……7
7. Creeping herbs, Corolla pubescent……..…….**3. S. alternata**
7. Prostate herbs, Corolla glabrous…….…..……**42. S. reptans**
8. Leaves narrow lanceolate-acuminate. ……...**45. S. schomburgkii**
8. Leaves oblong or ovate-elliptic.....9
9. Bracts long acuminate, flowers yellow…….……**11. S. chinensis**
9. Bracts otherwise, flowers pink, purple 11
10. Stamen 2. fertile.....12
10. Stamen 4.fertile.....14
11. Calyx equally lobes, united near base.....**24. S. glaucescens**

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11. Calyx subequally lobes, one lobe longer than other.....**40. S. quadrifaria**
12. Calyx subequally lobes, pollen globose echinate……**5. S. aprica**
12. Calyx equally lobes, pollen ellipsoid.....13
13. Bracts persistent, Large, strobiliform..... **36. S. palawanensis**
13. Bracts caducous, shortly panicle……..……..……..……**46. S. serrata**
14. Present leafless when flowering and fruiting ……..……**34. S. microcarpa**
14. Present with leaves when flowering and fruiting…….……..15
15. Leaves sessile..... 16
15. Leaves petiolate.....18
16. Inflorescence raceme with lax flowers distant ……..……....**39. S. pedunculosa**
16. Inflorescence axillary or terminal spike ……..…..17
17. Leave blade oblong-elliptic or oblanceolate, auriculate at base.… **7. S. auriculata**
17. Leave blade obovate, rounded at base.....**18. S. decumbens**
18. Stem and branches present winged.....**38. S. pateriformis**
18. Stem and branches without winged.....19
19. Corolla white.....20
19. Corolla yellow, pink to purple.....23
20. Inflorescence terminal panicle.....**48. S. tenuiflora**
20. Inflorescence subcapitate or spikes.....21
21. Inflorescence subcapitate, petiolar base forming rigid involucre..... **15.S. cruciata**
21. Inflorescence spikes. 22
22. Stamens included..... **43. S. rivularis**
22. Stamens exserted……..……..……**30. S. imbricata**
23. Inflorescence lax spikes, panicle or forming leafy branched panicle…….24
23. Inflorescence contracted, spikes, heads, capitellate…..…….32
24. Flowers yellow…….…….……**19. S. denticulata**
24. Flowers pink to purple……..……25
25. Bracteoles absent ……..……..…..…**27. S. heliophila**
25. Bracteoles present ……..……26
26. Inflorescence slender or weakly, rachis angle at ca. 60°.……..**25. S. hamiltoniana**
26. Inflorescence strongly, lax spikes or panicle…….……..……27
27. Inflorescence aggregated to forming a leafy branched panicle…..……**16. S. cusia**

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27. Inflorescence otherwise…….28

28. Plant anisophyllous, branchet usually zizag……..…**17. S. dalzielii var. inaqualis**

28. Plant isophyllous, branchet not zizag……..…….…..29

29. Bracts persistent ……..……....…..……... 30

29. Bracts caducous …….……...……...……. 31

30.Inflorescence panicle ……...…...…**32. S. lanceifolia**

30. Inflorescence very long flexuose spike……..**26.S. helferi**

31. Corolla ca. 1.2-2 cm……...…**37. S. paniculata**

31. Corolla ca.4-4.5 cm…….…….……....**2. S. alboviridis**

32. Capsules 2-seeded…….……..……..…….33

32. Capsules 4-seeded……..34

33. Inflorescence densely capitellate……..……..……**10. S. chiangdaoensis**

33. Inflorescence short spikes not capitellate……..……**23. S. fragrans**

34. Bracts caducous……..……..……..……35

34. Bracts persistent ……37

35. Leaves margin lobed……...……...…**41. S. repanda**

35. Leaves margin serrate, crenulate not lobed…..……...…….……..36

36. Leaves blades ovate, ……..……..…….……**22. S. erecta**

36. Leaves blades elliptic, elliptic-lanceolate……..…….……**20. S. dimorphotricha**

37. Inflorescence capitates, ……...…….38

37. Inflorescence short spikes ……..……..……..…41

38. Inflorescence densely hairy with eared appearance ……..……39

38. Inflorescence not above…….……40

39. Plant hirsute with brownish hairs ……**...13. S. consors**

39. Plant not present brownish hairs……**9.S. brandisii**

40. Leaves blades glabrous, bracts densely sticky glandular hairs……**33. S. maxwellii**

40 Leaves blades pilose…….……..…**21. S. echinata**

41 Anisophyllous ……42

41. Isophyllous……44

42. Inflorescence heads, blades base oblique .....**47. S. speciosa**

42. Inflorescence terminal spikes ……...……43

43. Leaves blades densely pilose on both surfaces……..….**6. S. argentea**

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43. Leaves blades sparsely hairy……..... **31. S. karensium**
44. Leaves blades glabrous ……..……45
44. Leaves blades pubescent…….…...……46
45. Bracts persistent, concave, rigid……..…….……..…..**1. S. abbreviata**
45. Bracts leaflike, petiolate…….……..…**44. S. rufescens**
46. Inflorescence headlike, very compact, elongate after flowering….. **4. S. anamitica**
46. Inflorescence simple or interrupted spikes……...……..47
47. Bracts ovate……..…..…..……..48
47.Bracts linear-lanceolate, linear-spathulate ……..……..49
48. Leaves blades ovate, thick subcoriaceous……..……...**14. S. corrugata**
48. Leaves blades elliptic……..……..…….…….. **29. S. hossei**
49. Bracts linear-lanceolate with margin ciliate.....**35. S. moschifera**
49. Bracts linear-spatulate, pubescent……..…… **49. S. tonkinensis**

1. Strobilanthes abbreviata Y.F. Deng & J.R.I. Wood, Bot. J. Linn. Soc. 150 (3): 377-379, f.11-12. 2006. (**Apendix Figure 4D**; **12A**)

Shrub, isophyllous, ca. 3 m high, stems terete, sulcate, striate, glabrous. *Leaves* petiolate, blades ca. 5–25 by 2.5–10 cm, oblong-elliptic, base long attenuate, decurrent, apex tapered with long acuminate, margin serrate, lateral nerves 8-10 pairs, glabrous; petioles ca. 1–2.5 cm long, glabrous. *Inflorescence* axillary, spikes, ca. 2–15 cm, basally rarely with a reduced second spike, bracts broadly oblong-obovate, ca. 0.5–0.6 by 0.2–0.4 cm, concave, rigid, persistent into fruit, apex abruptly truncate and with a short deciduous mucro, bracteoles lanceolate to oblong-lanceolate, ca. 1–1.5 by 0.1–0.2 cm, slightly shorter than calyx, concave, rather rigid, glabrous, apex obtuse. *Calyx* 5-lobed, glabrous, ca. 1.2–1.5 cm, slightly accrescent in fruit, subequally, united at base, lobes narrowly lanceolate, ca. 1–1.5 by 0.2–0.3 cm, glabrous except for apical glands that sometimes become stipitate, outside non-glandular except for a few sessile glands near apex, densely covered with cystoliths, apex acute to acuminate. *Corolla* dark purple, ca. 4–4.5 cm, sometimes apically bent, outside glabrous, tube basally cylindric and then ventricose and widened at mouth. *Stamen* 4, didynamous, filaments setose, anther thecae narrowly oblong. *Pollen* oblate spheroidal, 2-colpate,

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P=84.62±10.91, E=44.25±6.25, P/E=0.98, 20-24 ribs, coarsely bireticulate tectum. (**Apendix Figure 29**) *Ovary* comose, style ca. 2.5 cm, densely villous. *Capsule* oblong, ca.1.5–1.8 cm. pubescent. *Seeds* 4-seeded. Seeds ovate, flattened, densely pilose.

Thailand. —NORTHERN: Chiang Mai, Phayao, Nan, Phrae, Tak, Phitsanulok; NORTH-EASTERN: Loei; Eastern: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; South-Eastern: Chantaburi; Peninsular: Chumphon.

Distribution. — China, Cambodia, Myanmar and Assam.

Ecology.— Besides the stream in evergreen forest.

2. Strobilanthes alboviridis J.B. Imlay, Bull. Misc. Inform. Kew. 1939: 177. 1939.**—** *Semnostachya alboviridis* (J.B. Imlay) Bremek., Dansk Bot. Ark. 20: 71 1961. (**Appendix figure 12B**)

Shrub, anisophyllous, ca. 1.5 m high, stems terete, sulcate, striate, glabrous. *Leaves* unequal, petiolate, larger blades ca. 7–15 by 2.5–7 cm, smaller blade 2.5-5 by 2-4 cm, ovate-elliptic, base long attenuate and decurrent onto petiole, margin serrate, apex tapered, long acuminate and sometimes falcate, lateral nerves 6-7 pairs, glabrous and with numerous small cystoliths; petioles ca. 0.5–2.5 cm long. *Inflorescence* spikes, axillary and axillary, paniculate, ca. 5-10 cm long, flowers sub-opposite, subcapitate towards the apex, peduncles long, glandular-pubescent; bracts oblong, 0.6-0.8 cm long, densely glandular pubescent, caduceus before fruiting; bracteoles narrow lanceolate obtuse, pubescent. *Calyx* subequal, white with green at margin, 5-lobed, glabrous, slightly accrescent in fruit, subequally lobes narrowly lanceolate, ca. 1–1.5 by 0.2–0.3 cm, apex acute to acuminate. *Corolla* dark purple, ca. 4–4.5 cm, outside glabrous, tube basally cylindric and then ventricose upward. *Stamen* 4, didynamous, filaments setose, anther thecae narrowly oblong. *Ovary* minutely glandular-puberulous towards the apex, style ca. 2.5 cm long. *Capsule* oblong, 0.9–1 cm long, minutely glandular-puberulous. *Seeds* 4-seeded. Seeds ovate, flattened.

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Thailand.— SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chanthaburi, Trat; Peninsular: Chumphon, Ranong, Krabi, Phatthalung.

Distribution.— Sumatra.

Ecology.— In evergreen forest.

3. Strobilanthes alternata (Burm. f.) P. Charoenchai, unpublished.— *Ruellia alternata* Burm. f., Fl. Ind. (N. L. Burman) 135. 1768.— *R. colorata* Blume, Bijdr. Fl. Ned. Ind. 14: 795. 1826.— *Hemigraphis alternata* (Burm. f.) T. Anderson, J. Proc. Linn. Soc., Bot. 7: 114. 1863.— *R. colorata* Baill., Bull. Mens. Soc. Linn. Paris 2: 853. 1890.— *H. colorata* (Blume) Hallier f., Nova Acta Leop. 70: 199. 1897.— *Blechum cordatum* Leonard, Publ. Carnegie Inst. Wash. No. 461 (Bot. Maya Area) 200. 1936. (**Apendix Figure 5A**)

Herb, isophyllous, ca. 10-25 cm long, stem decumbent. *Leaves* petiolate, blades ca. 3-8 by 3-6 cm, ovate or ovate to cordate, somtime subequa-sided, base rounded or subcordate, apex obtuse, margin crenate, lateral nerves 5-6 pairs, purplish, springly hairy above, pubescent below; petioles ca. 1-4 cm long, hairy. *Inflorescence* simple, axillary or terminal spikes, ca. 2-3 cm long, bracts imbricated, sessile, oblong-ovate, obtuse, entire, puberulous, bracteoles small or absent. *Calyx* 5-lobed, ca. 0.5-0.8 cm long, lobe connate at the base, linear-acuminate, acute, ciliate. *Corolla* white with purple line, ca. 1.5-1.8 cm long, pubescent outside, tube narrow at base the venticose, lobes subequal, oblong. *Stamen* 4, didynamous, filament white, hairy. *Ovary* hairy at the apex, *Capsule* oblong, ca 0.5 cm. *Seeds* 8-16 seeded.

Thailand.— CENTRAL: Bangkok; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Pungoh, Satun.

Distribution.— Belize, Colombia, El Salvador, Honduras, Malaysia, Panama, Veneauela, Java, Annam and cochinchina.

Ecology.— Cultivated, undershrub for purple leaves.

Vernacular.— ดาดตะกั่ว (Dat ta kua), ฮ่อมครั่ง (Hom khrang) (Northern); ฤาษีผสมแล้ว (Ruesi phasom laeo) (Central); ห่งจี๋อึ้ง (Hong-chi-ang) (Chinese).

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4. Strobilanthes anamitica Kuntze, Revis. Gen. Pl. 2: 498. 1891.— *S. maclurei* Merrill., Philipp. J. Sci. 21: 354. 1922.— *Championella maclurei* (Merrill) C.Y. Wu & H.S. Lo, Fl. Hainan. 3: 592. 1974. (**Appendix figure 12C**)

Herb, isophyllous, perennials, ca. 50-100 cm high, stem reddish, erect or procumbent, rooting at nodes. *Leaves* petiolate, blades ca. 2-12 by 1.5-5 cm, oblong-ovate, base cuneate or subrounded, apex acuminate, margin crenulate, lateral nerves 4-5 pairs, hirsute; petioles ca. 1-2 cm long. *Inflorescence* spikes, headlike, axillary or terminal, ca. 3 cm, very compact, elongated after flowering, hirsute, bracts obovate, ca. 5 by 3 mm, bracteoles spatulate-linear, ca. 3 by 2 mm, hirsute, margin ciliate. *Calyx* 5-lobed, ca. 0.8 by 0.2 cm, hirsute. *Corolla* pale purple, ca. 3 cm long, pubescent. *Stamen* 4, didynamous, ca. 0.3-0.5 cm, pilose. *Ovary* comose, pubescent, style ca. 2.5 cm. *Capsule* oblong, ca. 6 mm, pubescent. *Seeds* 4-seeded.

Thailand.— NORTHERN: Lamphun, Lampang; SOUTH-WESTERN: Kanchanaburi.

Distribution.— China.

Ecology.— In evergreen forest.

Conservation Status.— Vulnerable (by author).

5. Strobilanthes aprica (Hance) T. Anderson, Fl. Hongk. 262: 1861.— *Gutzlaffia aprica* Hance, Hooker's J. Bot. Kew Gard. Misc. 1: 143. 1849.— *Phlebophyllum apricum* (Hance) Benth., Hooker's J. Bot. Kew Gard. Misc. 5: 131. 1853.— *S. dielsiana* W.W. Sm., Notes Roy. Bot. Gard. Edinburgh 8(38): 207–208. 1914.— *S. mairei* H. Lév., Cat, Pl. Yun-Nan 6: 1915.— *G. dielsiana* (W. W. Sm.) Moore, Jour. Bot. 63: 239. 1925.— *G. aprica* var. *glabra* H. S. Lo, Bull. Bot. Res., HarbinBull. Bot. Res., Harbin1(4): 102. 1981. (**Appendix figure 12D**)

Herb, isophyllous, perennials, ca. 50-80 cm high, stem quadrangular, sulcate, hirsute. *Leaves* petiolate, blades ca. 2-8 by1-3 cm, elliptic to oblong-elliptic, base cuneate, apex acute, margin entire and scagrid to thiny ciliate, lateral nerves 6-7 pairs, leathery, hairy; petioles ca. 0.5-1 cm long. *Inflorescence* short dense subcapitate

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spikes, clusters spikes, peduncle ca. 0.5-3 cm, bracts ovate-lanceolate, ca. 1-1.5 by 0.3-0.5 cm, bracteoles linear, sparsely pilose with multicellular trichomes. *Calyx* 5-lobed, ca, 1-1.2 by 0.4 cm, subequally linear, lower 2-lobes longer than upper 3-lobes. *Corolla* pale purple, funnel-sharped, ca. 2.5-3.5 cm. *Stamen* 2, exserted, ca. 1 cm, glabrous. *Ovary* pilose at tip, style pilose, ca. 2 cm. *Capsule* oblong, ca. 1 cm, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Lampang, Kamphaeng Phet; NORTH-EASTERN: Phetchabun, Loei; SOUTH-WESTERN: Kanchanaburi.

Distribution.— China, Indo-China and Myanmar.

Ecology.— Dry, opened, dipterocarp forest with *Pinus*.

Vernacular.— พญาสามราก (phaya sam rak), ยอทอง (Yo thong) (North, Northeastern).

Conservation Status.— Vulnerable (by author).

6. Strobilanthes argentea J.B. Imlay, Bull. Misc. Inf. Kew 1939: 121. 1939. (**Appendix figure 13A**)

Subshrub, anisophyllous, ca. 50-150 cm high, stem sulcate, hairy to glabrescent.*Leaves* petiolate, blades 5-12 by 3-6 cm, ovate, smaller blade ca. ½ sized of larger blade, attenuate and decurrent onto petiole, acute to acuminate apex, margin crenulate to dentate, lateral nerves 6-8 pairs, densely pilose with large trichome; petioles 0.5-5 cm long. *Inflorescence* spikes, terminal, ca. 2-5 cm, peduncle 1-2.5 cm, pilose, bracts oblong-lanceolate, densely pilose with gland-tipped and non-glandular trichomes. *Calyx* subequal 5-lobes, lanceolate, pilose. *Corolla* purple, ca. 2.5-.35 cm, tube ca. 0.2 cm venticose and strong bent upward, outside pilose inside glabrous. *Stamen* 4, didynamous, glabrous, ca.0.6-0.8 cm. *Ovary* pilose at tip, style ca. 2.5 cm. *Capsule* not seen.

Thailand.— NORTHERN: Chiang Mai.

Distribution.— China.

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Ecology.— Partly shaded, hill evergreen forest, 1,100–1,700 m.

Conservation Status.— Vulnerable (by author).

Note.— *S. argentea* has a smilar to *S. karensium*, different in more densely white hairy.

7. Strobilanthes auriculata Nees, Pl. Asiat. Rar. (Wall.). 3(12): 69 (86; t. 295). 1832.

Subshrubs, slightly to strongly anisophyllous, plietesial, ca. 0.5–2 m high, much branched, stems quadrangular, glabrous or sparsely hirsute. *Leaves* sessile, blades ca. 2–20 by 1.5–6 cm, narrowly to broadly oblong-elliptic or oblong-oblanceolate, base attenuate, cuneate, rounded, or auriculate, apex acuminate, margin serrate to undulate, lateral nerves 12–15 pairs, sparsely pilose on bothside. *Inflorescences* axillary or terminal, spikes, 3–10 cm, sometimes branched, peduncle 2–4 cm, quadrangular, sulcate; bracts ovate, 0.8–2 by 1-1.5 cm,imbricate, broadly ovate to obovate-spatulate, 0.4–1 cm, often becoming recurved, persistent, densely villous and ciliate, apex usually apiculate but sometimes rounded or emarginated; bracteoles absent. *Calyx* 6–12 mm, gland-tipped pilose, 5-lobed almost to base, lobes linear, unequal with 2 slightly shorter than others, margin usually ciliate, apex subacute. *Corolla* purple to dark violet, funnel-shaped, 2.5–3 cm, curved, outside glandtipped pilose on lobes, inside glabrous, tube basally cylindric and narrow for ca. 0.3 cm then slightly to strongly bent, abruptly inflated, and widened to ca. 2.5 cm at mouth, lobes ca. 0.3-0.5cm. Stamens 4, didynamous, filaments glabrous, ca. 0.2-0.4 cm. *Ovary* glabrous, style ca. 3.2 cm. *Capsule* narrowly oblong-obovoid, 0.8–1 cm, glabrous, *Seeds* 4-seeded.

KEY TO VARIETY

1. Leaves blade green, or with white veins……...…..……...**7a** var. **auriculata**
1. Leaves blade redish color, cultivated……...……...…….....**7b** var. **dyeriana**

7a. **Strobilanthes auriculata** Nees var. **auriculata** (**Apendix Figure 5B-C, 13D**)

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Subshrubs slightly to strongly anisophyllous, plietesial, ca. 0.5–2 m tall, much branched, stems quadrangular, glabrous or sparsely hirsute. *Leaves* sessile green colored, narrowly to broadly oblong-elliptic or oblong-oblanceolate, blade ca. 2–20 by 1.5–6 cm, sparsely pilose on bothside, lateral nerves 12–15 pairs, base attenuate, cuneate, rounded, or auriculate, margin serrate to undulate, apex acuminate. *Inflorescences* axillary or terminal, spikes, ca. 3–10 cm, sometimes branched, peduncle ca. 2–4 cm, quadrangular, sulcate, bracts ovate, ca. 0.8–2 by 1.5 cm, bracts imbricate, broadly ovate to obovate-spatulate, ca. 4–9 mm, often becoming recurved, persistent, densely villous and ciliate, apex usually apiculate but sometimes rounded or emarginated, bracteoles absent. *Calyx* 5 lobed, 6–12 mm, gland-tipped pilose, almost to base, lobes linear, unequal with 2 slightly shorter than others, margin usually ciliate, apex subacute. *Corolla* purple to dark violet, funnel-shaped, 2.5–3 cm, curved, outside glandtipped pilose on lobes, inside glabrous; tube basally cylindric and narrow for ca. 4 mm then slightly to strongly bent, abruptly inflated, and widened to ca. 2.5 cm at mouth, lobes ca. 0.3-0.5cm. Stamens 4, didynamous, filaments glabrous, shorter pair ca. 2 mm, longer pair ca. 4 mm, anther thecae oblong. *Pollen* prolate, 3-colporate, P=66.92±0.49, E=33.08±0.71, P/E=2.02, 16-18 pseudocolpi, 18-20 ribs, ribs with coarsely bireticulate tectum. (**Apendix Figure 31**) *Ovary* glabrous; style ca. 3.2 cm. *Capsule* narrowly oblong-obovoid, ca. 0.8–1 cm, glabrous, *Seeds* 4-seeded.

Thailand.— NORTHERN: Mae Hong Son, Chieng Mai, Phayao, Lamphun, Kamphaeng Phet, Tak; NORTH-EASTERN: Phetchabun, Loei, Mukdahan; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Saraburi; SOUTH-EASTERN: Trat.

Distribution.— India, Bangladesh, Nepal, Pakistan, Myanmar and Malaysia (Langkawi Island).

Vernacular.— จ๊าฮ่อม (Cha hom) (Lampang), คอกม้าแตก (Khok ma taek), หญ้าเล็กนาป่า (Ya lek na pa) (Chiang Mai)

Ecology.— Opened, roadsides, disturbed mixed deciduous forest, 750 m.

Note— *S. auriculata* is one of the few species of Strobilanthes that can be recognized in a sterile state with confidence on account of its sessile and auriculate at base.

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7b. **Strobilanthes auriculata** Nees var. **dyeriana** (Mast.) J.R.I. Wood.— *Strobilanthes dyeriana* Mast. ex Gard. Chron. 1: 442. 1893; et in Rev. Hortic. 65: 201. 1893.— *Perilepta dyeriana* (Mast.) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2, 41(1): 194 1944.

Subshrubs slightly to strongly anisophyllous, plietesial, 0.5–2 m tall, much branched, Stems quadrangular, glabrous or sparsely hirsute. *Leaves* sessile, blades ca. 2–20 by 1.5–6 cm, narrowly to broadly oblong-elliptic or oblong-oblanceolate, base attenuate, cuneate, rounded, or auriculate, margin serrate to undulate, apex acuminate, lateral nerves 12–15 pairs, reddish-green colored, sparsely pilose on bothside. *Inflorescences* axillary or terminal, spikes, ca. 3–10 cm, sometimes branched, peduncle ca. 2–4 cm, quadrangular, sulcate, bracts ovate, ca. 0.8–2 by 1.5 cm; bracts imbricate, broadly ovate to obovate-spatulate, ca.0.3–0.8 cm, often becoming recurved, persistent, densely villous and ciliate, apex usually apiculate but sometimes rounded or emarginated; bracteoles absent. *Calyx* 5-lobed, ca. 0.6–1.2 by 0.2-0.4 cm, gland-tipped pilose, almost to base, lobes linear, unequal with 2 slightly shorter than others, margin usually ciliate, apex subacute. *Corolla* purple to dark violet, funnel-shaped, ca. 2.5–3 cm, curved, outside glandtipped pilose on lobes, inside glabrous, tube basally cylindric and narrow for ca. 0.4 cm then slightly to strongly bent, abruptly inflated, and widened to ca. 2.5 cm at mouth, lobes ca.0.3-0.5cm. Stamens 4, didynamous, filaments glabrous, ca. 0.2-0.4 cm. *Ovary* glabrous, style ca. 3-3.2 cm. *Capsule* narrowly oblong-obovoid, ca. 0.8–1 cm, glabrous, *Seeds* 4-seeded.

Thailand.— NORTHERN: Lampang.

Vernacular.— นาคบริพัตร (Nak boriphat), นาคเบญจพรรณ (Nak benchaphan) (Bangkok).

Ecology.— In evergreen forest.

Note.— *S. auriculata* var. *dyeriana* (Masters) J.R.I. Wood with leaf blade abaxially reddish rather than green.

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8. Strobilanthes bilabiata J.R.I. Wood, Kew Bull. 64(1): 33. 2009.

Treelet, anisophyllous, ca. 2-5 m high, with dense, spreading crown, stem 12 cm in diameter, branched quadrangular to terete, sulcate, glandular pilose to glabrescent. *Leaves* unequal in each pair, petiolate, blades ca. 5–20 by 2–10 cm, elliptic to oblong-elliptic, smaller of pair ca. 3/4 size of larger one, base cuneate and attenuate, apex acute to caudate, margin serrulate and ciliate, lateral nerves 7–10 pairs, roughly hirsute; petioles ca. 1–3 cm long. *Inflorescence* spikes, 1-sided, 5-10 cm long, rachis somtime zizag, peducle ca. 4 cm long, glandulous pilose, bracts obovate, dentate, glandular-pilose, longer with caudate tips giving inflorescences an eared appearance, inner ones smaller, indumentum variable, white sericeous, with gland-tipped or non-glandular trichomes, and apically often becoming brownish; bracteoles oblanceolate, ca. 0.5–1 cm. *Calyx* 5-lobed, ca. 1.5-1.8 cm, 2-lipped, oblong, obtuse apex, entire, glandular pilose. *Corolla* purple, ca. 3.5–4 cm, curved, ventricose. *Stamen* 4, didynamous, ca. 1.2-1.5 cm, glabrescent. *Ovary* pilose, style ca. 2.5 cm, white pilose. *Capsule* not seen.

Thailand.— NORTHERN: Chieng Mai.

Ecology.— In evergreen forest.

Conservation Status.— Endangered (EN) (Wood and Scotland, 2009).

9. Strobilanthes brandisii T. Anderson, J. Linn. Soc., Bot. 9: 475.1867.
— *S. evrardii* Benoist, Bull. Soc. Bot. France 80: 731. 1933 (publ.) 1934. (**Apendix Figure 5D**)

Subshrubs, anisophyllous, ca. 0.5–2 m tall, much branched, stems quadrangular, basally glabrescent, apically rust-colored setose. *Leaves* petiolate, blades ca. 3–15 by 2–7 cm, ovate-elliptic to oblong-elliptic, smaller of pair ca. 3/4 size of larger one, roughly hirsute, lateral nerves 7–10 pairs, base cuneate and attenuate, apex acute to caudate, margin serrulate and ciliate, petioles ca. 1–3 cm long. *Inflorescence* terminal, heads, often yellowish, 8–10-flowered, rachis densely white sericeous with gland-tipped trichomes, bracts oblong-lanceolate, ca. 0.5–0.8 cm, outer

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ones longer with caudate tips giving inflorescences an eared appearance, inner ones smaller, indumentum variable, white sericeous, with gland-tipped or non-glandular trichomes, and apically often becoming brownish, bracteoles oblanceolate, ca. 0.5–1 cm. *Calyx* 5-lobed, ca. 0.5–1 cm, almost to base, lobes linear-oblanceolate, densely white hairy toward base but slightly rust-colored toward apex, apex acute. *Corolla* purple, ca.3–3.5 cm, curved, tube basally cylindric and then ventricose upward, lobes ovate, ca. 0.5 cm. *Stamen* 4, didynamous, filament ca. 1.4-1.6 cm long, glabrescent. *Ovary* densely white pilose, style ca. 2.5 cm, white pilose. *Capsule* oblong, 0.6–1 cm, apically white pilose, *Seeds* 4-seeded.

Thailand.— NORTHERN: Chieng Mai, Tak; NORTH-EASTERN: Loei; EASTERN: Chaiyaphum; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon.

Distribution.— Myanmar.

Ecology.— Hill evergreen forest, 800-1,000 m.

10. Strobilanthes chiangdaoensis Terao, Acta Phytotax. Geobot. Vol. 32 no. 1-4: 31 1981.

Shrub, isophyllous, stem subteretes, densely pubescent. *Leaves* petiolate, subequal, blades ca. 3-6.5 by 1.5-3 cm, ovate-elliptic, base cuneate, apex acuminate, margin crenulate or crenulate-dentae, lateral nerves 9-11 pairs, densely hairy; petioles ca. 1.5-3 cm long. *Inflorescence* spike, terminal or axillary, short densely capitellate, 2-2.5 cm long, pubescent, bracts oblong, ca.0.8-1.8 by 0.2-0.3 cm, hirsute, margin denticulate, persistent, bracteoles oblong-linear, ca.0.35-0.5 by 0.3-0.4 cm, hairy, persistent. *Calyx* 5-lobed, redish, ca. 0.5-0.8 long, oblong-linear, pubescent. *Corolla* pale purple, ca.1.5-1.8 cm, tube ca. 0.5 cm, venticose upward. *Stamen* 4, didynamous, filament glabrous. *Ovary* hariy. *Capsule* ovate-elliptic, ca. 0.5-0.8 cm. pubescent. *Seeds* 2-seeded.

Thailand.— NORTHERN: Chiang Mai, Chiang Rai.

Ecology.— On exposed limestone hill, 1,050-1,900 m.

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Vernacular.— ย้อมเชียงดาว (Hom Chiang Dao) (Chiang Mai).

Conservation Status.— Endermic (Santisuk *et al.* 2006).

11. Strobilanthes chinensis (Nees) J.R.I. Wood & Y.F. Deng, Bot. J. Linn. Soc.150 (3): 388. 2006.— *Ruellia chinensis* Nees, Prodr. 11: 147. 1847.— *H. chinensis* (Nees) T. Anderson ex Hemsl. Jour. Linn. Soc., Bot. 26(175): 238. 1890.— *Sericocalyx chinensis* (Nees) Bremek.Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 163. 1944.— *Sericocalyx thailandicus* Brem., Dansk. Bot. Ark. 20: 68 1961. (**Apendix Figure 6A**)

Herb or shrub, anisophyllous, ca. 50-100 cm high, branched, decumbent, rooting at the lower nodes, sub-quadrangular. *Leaves* petiolate, blades 5-15 by 2-4 cm, oblong, base shorty decurrent on the petiole, apex acuminate, margin entire, lateral nerve 6-7 pairs, roughly and sparsely hairy above; petioles 0.5-2 cm long, hairy. *Inflorescence*s pikes, axillary and terminal, short, dense, strobilate, 2-4 cm long, peduncle 1-3 cm long, hirsute, bract ovate to oblong, 1-2 cm long, acuminate, hirsute, nerved, ciliated, bracteoles linear-acuminate, 0.5-0.8 cm long. *Calyx* 5-lobed, ca. 0.8-1 cm long, hairy, lobes linear acuminate. *Corolla* yellow, minutely puberulous outside, ca 2-2.5 cm long, tube narrow at the base then broadening, lobes subequal, rounded. *Stamen* 4, didynamous, filament hairy. *Ovary* hairy. *Capsule* oblong, ca.0.8 cm long, pubescent. *Seeds* 8-seeds.

Thailand.— NORTHERN: Mae Hong Son, Tak; NORTH-EASTERN: Nongkhai; EASTERN: SiSaKet; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Saraburi; SOUTH-EASTERN: Chon Buri, Chanthaburi; PENINSULAR: Narathivat.

Distribution.— China and Indo-China.

Ecology.— Along path in evergreen forest.

12. Strobilanthes confinis (T. Anderson) P. Charoenchai, unpublished.
— *Hemigraphis confinis* T. Anderson, J. Linn. Soc., Bot. 9: 463. 1867.— *H. alternata* (Burm.) T. Anderson, J. Linn. Soc. Vii 114. 1864; C. B. Clarke, J. As. Soc. Beng.

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Lxxiv 653. 1908.— *R. alternata* Burm., Fl. Ind. 135. 1768.— *R. discolor* Nees in DC. Prodr. xi 149. 1847.— *R. bumeana* Nees in DC. Prodr. xi 149. 1847.

Herb, isophyllous, ca. 20-50 cm. high, stem slender, pubescent at first becoming glabrous. *Leaves* petiolate, blades ca. 2-5.5 by 1-2.5 cm, lanceolate, base attenuate, apex acute, margin crenate or subentire, lateral nerves 4-5 pairs,glabrous; petioles ca. 0.3-1 cm long. *Inflorescence* spikes, terminal and on short lateral branches, ca. 2-3 cm long, bracts imbricated, spathulate-ovate, ca. 0.8-1 cm long, hairy, bracteoles linear-acuminate, 0.5 cm long, hispid and long-ciliate, with gland-tipped. *Calyx* 5-lobed, ca. 0.8 cm long, lobes subequal, lanceolate, acuminate. *Corolla* pink, glabrous outside, ca. 1-1.2 cm long, tube narrow ate base, lobes subequal, rounded. *Stamen* 4, didynamous, glabrous, anther oblong ca. 0.1 cm. *Ovary* glabrous, style ca. 0.5 cm long, hairy. *Capsule* oblong, ca.0.6-0.8 cm long. *Seeds* 8-seeded.

Thailand.— NORTH-EASTERN: Loei; CENTRAL: Saraburi; PENINSULAR: Nakhon Sritamarat, Krabi.

Distribution.— Malaya.

Ecology.— Growing on banks of river, edge of evergreen forest.

Vernacular.— ยา ยา งู (Ya ya ngu).

13. Strobilanthes consors C.B. Clarke, Bot. Jahrb. Syst. 41(2): 66 (-67). 1907; Craib in Kew Bull. 436. 1911; R. Ben. In Lec. Fl. Gen. Ind. Ch. 4:672. 1935.

Shrub, isophyllous, ca. 80-120 cm high, decumbent, erect, stem terete, hirsute with spreading brownish hairs. *Leaves* petiolate, subequal, blades ca. 3-8 by 2-4 cm, ovate or oblong, base acute or cuneate, apex acute, margin crenate-serrate and ciliate, lateral nerves 7-8 pairs, sparsely tomentose, densely lineolate, hairy on both surfaces; petioles 1-4 cm long, pubescent. *Inflorescence* spikes capitulate, short densely axillary or terminal, ca. 2-3 cm long, densely hairy, peduncle ca 3 cm, bracts ovate oblong, ca. 0.6x0.3 cm, white hairy both surface, bracteoles lanceolate. *Calyx* 5-lobed, subequally lobed, ca. 1 cm, pilose, margin ciliate. *Corolla* purple, 5-lobes, ca. 43 cm long, soft pilose outside, tube ca.0.3 cm, venticose upward. *Stamen* 4, didynamous,

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glabrous. *Ovary* oblong, pilose. *Capsule* oblong, ca. 1 cm long, pubescent at apex. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Lampang; NORTH-EASTERN: Loei; SOUTH-WESTERN: Kanchanaburi.

Ecology.— Nature trail in evergreen forest.

14. Strobilanthes corrugata J.B. Imlay, Bull. Misc. Inform. Kew 1939: 123. 1939. (**Apendix Figure 6B; 14B**)

Subshrub, isophyllous, ca. 50-80 cm high, stem quadrangular, ridged, with long and short redish-colored hirsute. *Leaves* petiolate, subequal, blades ca. 3-8 by 2-4 cm, ovate, base unequal-sided, apex acuminate to sub-acute, margin crenate-serrate and ciliate, lateral nerves 5-6 pairs, sparsely tomentose; petioles ca.1-4 cm, pubescent. *Inflorescence* spikes, axillary or terminal, ca. 2-4 cm long, densely hairy, peduncle ca. 0.5 cm, bracts ovate, ca. 0.6 by 0.3 cm, hairy both surface, bracteole linear. *Calyx* 5-lobes, subequally lobed, ca. 1 cm, pilose, margin ciliate. *Corolla* bluish purple, 5-lobes, ca. 2.5-3 cm long, soft pilose outside, tube ca. 0.3 cm, venticose upward. *Stamen* 4, didynamous, glabrous. *Pollen* prolate, 3-colporate, P=70.83±0.56, E=48.33±1.25, P/E=1.46, 12-14 pseudocolpi, 14-16 ribs, ribs with coarsely reticulate tectum. (Apendix Figure 33) *Ovary* oblong, glabrous. *Capsule* oblong, ca. 1-1.5 cm long, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai.

Ecology.— Opened, limestone hill.

Vernacular.— ฮ้อมดอยเชียงดาว (Hom Chiang Dao) (Chiang Mai).

Note.— Plants with aromatic smell.

Conservation Status.— Vulnerable (by author).

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15. Strobilanthes cruciata (Bremek.) Terao, Act. Phyt. Geo.ca 31: 59. 1980. —*T. nagaensis* Bremek.Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect.41(1): 299. 1944.—*Tetragoga cruciata* Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2.2. Amsterdam 41(1): 300. 1944.

Subshrub, anisophyllous, ca. 1-2 m high, stem quadrangular, rust-colored hirsute or glabrous. *Leaves* petiolate, blades ca. 4-12 by 2-5 cm, ovate to ovate-lanceolate, smaller blade ca. 1/3 in sized of larger, base cuneate, apex acuminate, margin serrate and ciliate, lateral nerves 7-9 pairs, sparsely tomentose; petioles ca. 1-2 cm, pubescent. *Inflorescence* subcapitate, axillary or terminal, peduncle ca. 2 cm, glandulous, pillose, outer-bracts leaflike, petiolar base forming rigid involucre around capitulum, ca. 2 cm, inner-bracts pilose, glandulous tiped pubescent, bracteole linear. *Calyx* 5-lobed, ca. 1 by 0.4 cm, pilose, margin ciliate. *Corolla* white, 5-lobes, ca. 2.5 cm, curved, glabrous, tube ca. 0.3 cm, venticose upward. *Stamen* 4, didynamous, glabrous. *Ovary* oblong, glabrous.*Capsule* fusiform, ca. 1-1.5 cm long, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Nan; NORTH-EASTERN: Loei; PENINSULAR: Chumphon.

Distribution.— China, India, Myanmar and Indonesia.

Ecology.— In evergreen forest.

Conservation Status.— Data Deficient (DD), very windspread but rarely collected (Wood and Scotland, 2009).

16. Strobilanthes cusia (Nees) Kuntze**,** Rev. Gen. Pl. 2: 499. 1891.— *Goldfussia cusia* Nees Pl. Asiat. Rar. 3: 88. 1832.— *Ruellia indigofera* Griff., Journ. 237.— *S. flaccidifolia* Nees, Prodr. [A. P. de Candolle] 11: 194. 1847.— *Dipteracanthus calycinus* Champ. ex Benth., Hooker's J. Bot. Kew Gard. Misc. 5: 133. 1853— *Strobilanthes championii* T. Anderson ex Benth. Fl. Hongk. 261–262. 1861.— *S. balansae* Lindau, Bull. Herb. Boissier v. 652. 1897.— *Baphicacanthus cusia* (Nees) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. Amsterdam 41(1): 190. 1944. (**Apendix Figure 6C**)

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Subshrub, anisophyllous, ca. 100-150 cm high, branched, drying blackish, stem glabrous or minutely brown puberulent. *Leaves* petiolate, blades ca. 5-20 by 2-10 cm, elliptic to ovate, base attenuate, apex acute, margin entire or serrate, lateral nerves 8-10 pairs, glabrous; petioles ca.0.5-5 cm long. *Inflorescence* bracteates spikes, terminal or axillary, ca. 2-8 cm, often aggregated to form a leafy branched panicle, bracts leaflike, oblanceolate, obovate or spatulate, ca. 1-1.5 cm, bracteoles linear-oblanceolate, deciduous. *Calyx* 5-lobed, ca. 0.5-1.5 cm, accrescent to ca. 2.5 cm in fruit, puberulent. *Corolla* purple, ca. 3.5-5 cm, glabrous. *Stamen* 4, didynamous, ca. 0.3-0.8 cm, glabrous. *Ovary* oblong, puberulent at apex, style ca. 3 cm, glabrous. *Capsule* oblong, ca.1.5-2 cm, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Nan; NORTH-EASTERN: Petchabun; SOUTH-WESTERN: Prachupkirikhun; EASTERN: Nakhon Ratchasima; PENINSULAR: Pattani.

Distribution.— India, Bangladesh, Bhutan, China and Indochina.

Ecology.— Cultivated plants for blue dyes.

Vernacular.— คราม (Khram) (General); ครามหลอย (Khram loi) (Shan-Mae Hong Son); ฮ่อม (Hom) (Northern); ฮ่อมเมือง (Hom mueang) (Nan).

Note.— All part used for blue Dyes.

17. Strobilanthes dalzielii (W.W. Sm.) Benoist, var. **inaequalis** R. Ben., Not. Syst. 5: 109. 1935; Fl. Indo-Chine 4: 679 1935.— *Acanthopale dalzielii* W. W. Sm., Not. R. Bot. Card. Edinb. 11:193. 1919.— *P. inaequalis* (R. Ben.) Brem., Verh. Akad. Wet. Afd. Nat. Sect. 2. 41(1): 305 1944.— *Pteroptychia dalzielii* (W. W. Sm.) H. S. Lo, Fl. Hainan 3: 592. 1974.

Shrub or perennial herb, strongly anisophyllous, ca. 50-100 cm high, stem slender, slightly pubescent. *Leaves* petiolate or sessile,subequal, smaller blades 2-4 by 1-2 cm, larger blades 10-12 by 3-5 cm, ovate ot ovate-lanceolate, base oblique, apex acuminate, margin entire, lateral nerves 3-5 pairs, glabrous and pubescent along the veins; petioles ca. 0-0.5 cm long. *Inflorescence* spikes, axillary or terminal, ca. 3-5 cm long, branchet usually zigzag, sparsely white puberulent, bracts lanceolate, ca. 0.3 by

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0.1 cm, bracteoles linear, ca. 0.5 cm long, glabrous. *Calyx* 5-lobed, densely white pilose at base and midvein. *Corolla* purple, 3-4.5 cm, curved, tube ca. 0.3 cm and then venticose upward, 5-lobes suborbicular. *Stamen* 4, slightly exserted. *Ovary* glabrous, ca. 3 cm long, style pilose. *Capsule* linear-oblong, 1.5-2 cm, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Nan.

Distribution.— China and Indo-China.

Ecology.— In evergreen forest; alt. 1,500-1,600 m.

18. Strobilanthes decumbens (Bremek.) J. R. I. Wood, Kew Bull.58(1): 97. 2003.— *Larsenia decumbens* Bremek., Dansk Bot. Ark. 23: 205. 1965.

Subshrub, slightly to strongly anisophyllous, plietesial, ca. 0.5–2 m tall, much branched, Stems quadrangular, glabrous or sparsely hirsute. *Leaves* sessile, blades ca. 2–8 by 1.5–6 cm, obovate,base attenuate, cuneate, rounded, apex acuminate, margin serrate to undulate, lateral nerves 6–7 pairs, reddish-green colored, sparsely pilose on bothside, *Inflorescences* axillary or terminal, spikes, ca. 3–10 cm, sometimes branched, peduncle ca. 2–4 cm, quadrangular, sulcate, bracts ovate, ca.0.8–2 by 0.3–0.8 cm, imbricate, broadly ovate to obovate-spatulate, often becoming recurved, persistent, densely villous and ciliate, apex usually apiculate but sometimes rounded or emarginated, bracteoles absent. *Calyx* 5-lobed, ca. 0.6–1.2 cm, gland-tipped pilose, almost to base, lobes linear, unequal with 2 slightly shorter than others, margin usually ciliate, apex subacute. *Corolla* purple to dark violet, funnel-shaped, ca. 2.5–3 cm, curved, outside glandtipped pilose on lobes, inside glabrous, tube basally cylindric and narrow for ca. 4 mm then slightly to strongly bent, abruptly inflated, and widened to ca. 2.5 cm at mouth, lobes ca. 0.3-0.5cm. Stamens 4, didynamous, filaments glabrous, ca. 0.2-0.4 cm. *Ovary* glabrous, style ca. 3.2 cm. *Capsule* narrowly oblong-obovoid, 0.8–1 cm, glabrous, *Seeds* not seen.

Thailand.— NORTHERN: Tak; SOUTH-WESTERN: Kanchanaburi.

Ecology.— In mixed deciduous forest.

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Conservation Status.— Vulnerable (by author).

19. **Strobilanthes denticulata** (Nees) T. Anderson, J. Linn. Soc., Bot. 9: 483. 1867. —*Asystasia denticulata* Nees in wall., Pl. Asiat. Rar. 3: 89. 1832.—*S. flaccidifolia* Nees in DC., Prod. 11: 194. 1847.—*Triaenacanthus ("Triaenanthus") griffithianus* Nees in DC., Prod. 11: 169. 1847.—*S. griffithiana* (Nees) T. Anderson., J. Linn. Soc., Bot. 9: 481. 1867.

Herb, anisophyllous, perennials, ca. 0.5–1.5 m high, erect, branched, stems glabrous or minutely brown puberulent. *Leaves* petiolate, blades ca. 4–20 by 2–10 cm, elliptic to ovate, base attenuate, apex acute, margin serrate, lateral nerves 7–10 pairs, glabrous or abaxially minutely puberulent along veins; petioles ca. 0.5–5 cm long. *Inflorescence* lax, terminal or axillary, bracteate spikes, ca. 1–6 cm, leafy branched panicle, peduncle ca. 2–4 cm, bracts, oblanceolate, obovate, or spatulate, 1–2 cm, basally usually sterile, bracteoles linear-oblanceolate, 2–3 mm, deciduous before bracts. *Calyx* 5-lobed, ca. 0.2-0.3 cm in flower then accrescent to ca. 2.5 cm in fruit, minutely puberulent, almost to base. Corolla yellow, ca. 3.5–5 cm, straight to slightly bent, outside glabrous, tube basally cylindric then slightly curved and venticose upward, lobes oblong, subequal. *Stamen* 4, didynamous, filaments ca. 1.2-1.5 cm, glabrous. *Ovary* 4, style ca. 2.2 cm, glabrous. *Capsule* ca. 0.8- 1 cm, glabrous. *Seeds* 4-seeded. ca. 0.3 cm, covered with appressed trichomes.

Thailand.— SOUTH-WESTERN: Kanchanaburi.
Ecology.— In dry evergreen forest.
Conservation Status.— Vulnerable (by author).

20. Strobilanthes dimorphotricha Hance, J. Bot. 21(12): 355. 1883.—*S. geniculata* C.B. Clarke, Fl. Brit. India 4: 459. 1884.—*S. chaffanjonii* H. Lév., Repert. Spec. Nov. Regni Veg. 12: 20. 1913.—*S. marchandii* H. Lév. Repert. Spec. Nov. Regni Veg. 12: 19. 1913.—*S.seguinii* H. Lév., Repert. Spec. Nov. Regni Veg. 12: 19. 1913.—*S. equitans* H. Lév. Repert. Spec. Nov. Regni Veg. 12: 20. 1913.—*S. psilostachys* C.B. Clarke ex W. W. Sm., Notes Roy. Bot. Gard. Edinburgh 10: 198.

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1918.—*S. gracilicaulis* Benoist, Notul. Syst. (Paris) 8: 145.1939.— *Goldfussia dimorphotricha* (Hance) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 231. 1944.—*G. geniculata* (C.B. Clarke) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 231. 1944.—*G. psilostachys* (C.B. Clarke ex W. W. Sm.) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 232. 1944.—*G. equitans* (H. Lév.) E. Hossain, Notes Roy. Bot. Gard. Edinburgh 32(3): 406. 1973.—*G. chaffanjonii* (H. Lév.) E. Hossain, Notes Roy. Bot. Gard. Edinburgh 32(3): 406. 1973.—*G. seguinii* (H. Lév.) C.Y. Wu & C.C. Hu, Fl. Reipubl. Popularis Sin. 70: 169. 2002.

Herb or subshrub, isophyllous or anisophyllous, perennials, ca, 50-150 cm high, branched, stem glabrous or pubescent. *Leaves* petiolate,subequal, blades ca. 2-15 by 1-5 cm, elliptic, elliptic-lanceolate, oblong or oblong-elliptic, smaller ca. 1/3 sized of larger blade, base cuneate to attenuate, acuminate, apex caudate or acute, margin serrulate, lateral nerves 5-8 pairs, glabrescent or slightly whitish pubescent along veins; petioles ca. 0.5-2 cm long. *Inflorescence* head-like spikes, subspherical, very compact, axillary or terminal, peduncle ca. 2 cm, bracts ovate-elliptic, ca. 1-1.5 cm, cauducous, glabrous, apex acute to acuminate, bracteoles lanceolate, ca. 0.5 cm, cauducous, glabrous. *Calyx* 5-lobed, ca. 0.5-1 cm, accrescent to 1.5 cm, subequally lobes, one lobes slightly longer than others. *Corolla* whitish pink, ca. 3-5 cm long, lobes subequal, rounded. *Stamen* 4, didynamous, filament ca. 0.5-0.8 cm long, glabrous. *Ovary* pilose, style ca. 3 cm long, pilose. *Capsule* oblong-calvate, ca. 1.5 cm long, pubescent. *Seeds* 4-seeded.

KEY TO SUBSPECIES

1.Strongly anisophyllous, apex acuminate to caudate …. **20a**. subsp. **dimorphotricha**
1.Isophyllous, apex acute……..……..……**20b.** subsp. **rex**

20a. Strobilanthes dimorphotricha Hance subsp. **dimorphotricha** (**Appendix figure 13B**)

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Herb or subshrub, strongly anisophyllous, perennials, ca. 50-150 cm high, branched, stem glabrous or pubescent. *Leaves* petiolate, blades ca. 2-15 by 1-5 cm, oblong or oblong-elliptic, smaller ca. 1/3 sized of larger blade, base cuneate to attenuate, acuminate, apex caudate, margin serrulate, lateral nerves 5-8 pairs, glabrescent or slightly whitish pubescent along veins; petioles ca.0.5-2 cm long. *Inflorescence* head-like spikes, subspherical, very compact, axillary or terminal, peduncle ca. 2 cm, bracts ovate-elliptic, ca. 1 cm, cauducous, glabrous, apex acute to acuminate, bracteoles lanceolate, ca. 0.5 cm, cauducous, glabrous. *Calyx* 5-lobed, ca. 0.5-1 cm, accrescent to 1.5 cm, subequally lobes, one lobes slightly longer than others. *Corolla* whitish pink, ca. 3-4 cm, lobes subequal, rounded. *Stamen* 4, didynamous, ca. 0.5-0.6 cm, filament glabrous. *Ovary* pilose, style ca. 3 cm, pilose. *Capsule* oblong-calvate, ca.1.2 cm, pubescent. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Nan; NORTH-EASTERN: Phetchabun, Loei; PENINSULAR: Ranong.

Distribution.— China, India, Myanmar and Indo-China.

Ecology.— Thickets on limestone hills, streamsides or thickets by streams.

Conservation Status.— Vulnerable (by author).

20b. **Strobilanthes dimorphotricha** Hance subsp. **rex** (C.B. Clarke) J.R.I. Wood, Kew Bulletin 61(1): 13. 2006.— *S. anfractuosa* C.B. Clarke, Bot. Jahrb. Syst. 41(2): 66. 1907.— *S. penstemonoides* var. *anfractuosa* (C.B. Clarke) Benoist, The record derives from www.Tropicos org (data supplied on 2555-04-18).— *S. penstemonoides* var. *rex* (C. B. Clarke) Benoist, The record derives from www.Tropicos org (data supplied on 2555-04-18).— *S. rex* C.B. Clarke, Bot. Jahrb. Syst. 41(2): 68. 1907.— *Goldfussia anfractuosa* (C.B. Clarke) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 230. 1944.— *G. rex* (C.B. Clarke) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 232. 1944. (**Apendix Figure 6D; 13C**)

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Herb or subshrub, isophyllous or weakly anisophyllous, perennials, ca. 50-150 cm high, branched, stem glabrous or pubescent. *Leaves* petiolate, blades ca. 3-15 by 2-5 cm, elliptic, elliptic-lanceolate, base cuneate to attenuate, apex acute, margin serrulate, lateral nerves 8-9 pairs, glabrescent or slightly whitish pubescent along veins; petioles 0.5-2 cm long. *Inflorescence* headlike spikes, subspherical, very compact, axillary or terminal, peduncle ca. 2 cm, bracts ovate-elliptic, 1-1.5 cm, cauducous, glabrous, apex acute to acuminate, bracteoles lanceolate, ca. 0.5 cm, cauducous, glabrous. *Calyx* 5-lobed, ca. 0.5-1 by 0.3 cm long, accrescent to 1.5 cm, subequally lobes, one lobes slightly longer than others. *Corolla* whitish pink, ca. 3-5 cm long, lobes subequal, rounded. *Stamen* 4, didynamous, filament ca. 0.5-0.8 cm, glabrous. *Ovary* pilose, style ca. 3 cm, pilose. *Capsule* oblong-calvate, ca.1.5 cm, pubescent. *Seeds* 4-seeded.

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Nan, Lamphun, Lampang, Phitsanulok; NORTH-EASTERN: Phetchabun, Loei Khon Kaen; EASTERN: Chaiyaphum, Phitsanulok; SOUTH-WESTERN: Kanchanaburi.

Vernacular.— หญ้าปีกไก่ดำ (Yah Pik Kai Dam).

Ecology.— In evergreen forest.

21. Strobilanthes echinata Nees, Pl. Asiat. Rar. 3:85. 1832.—*S. jugorum* Benoist, Bull. Soc. Bot. France 81: 601. 1934.—*Tetraglochidium jugorum* (Benoist) Bremek., Proc. Kon. Ned. Akad. Wetensch.,Ser. B 60: 2. 1957.—*Goldfussia echinata* (Nees) N.P. Balakr., Fl. Jowai 2: 355. 1983. (**Appendix figure 14C**)

Shrub, anisophyllous, stem subterete to quadrangular, sulcate, pubescent with brownish trichomes or grabescent. *Leaves* petiolate, blades ca. 5-20 by 1.2-8 cm, ovate to ellipitc, smaller ca. ½ of larger blade, base cuneate and decurrent onto petioles, apex acuminate, margin crenate-serrate, lateral nerves 5-6 pairs, pilose to subglabrous; petioles ca. 0.5-3 cm long, slightly winged, pubescent. *Inflorescence* capitate, 2-5-flowered, peduncle short,outer bracts ovate or ovate-oblong ca. 3 by 2 cm, persistent, margin crenate-serrate, inner bracts obovate to spatulate, rounded, ca. 2 by 0.5 cm, margin cilliate, bracteoles linear to oblanceolate, ca. 2 by 0.6 cm,

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pubescent, margin entire. *Calyx* 5-lobed, ca. 1.5-2 by 0.5 cm, pubescent, subequally linear. *Corolla* purple, ca. 4-5.5 cm long, tube ca. 0.3 cm, venticose upward, glabrous. *Stamen* 4, didynamous, ca. 0.3-1 cm long, glabrous. *Ovary* glabrous, style ca. 2.5 cm, hirsute. *Capsule* fusiform, ca. 1.5 cm, pilose. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Chiang, Nan; NORTH-EASTERN: Loei; EASTERN: Chaiyaphum, Nakhon Rachasima; SOUTH-WESTERN: Prachuap kiri khan; CENTRAL: Saraburi, Nakhon Nayok; SOUTH-EASTERN: Prachinburi, Chanthaburi, Trat; PENINSULAR: Ranong, Nakhon Si Thammarat , Trang, Satun, Songkhla, Pattani.

Distribution.— China, India, Bhutan, and Indo-China, Myanmar, Indonesia and Malaysia.

Ecology.—In evergreen forest.

Vernacular.— คราม แงะ (Khram ngae) (Pattani).

22. **Strobilanthes erecta** C.B. Clarke, Bot. Jahrb. Syst. 41(2): 67. 1907. (**Appendix figure 14D**)

Herb, isophyllous to weakly anisophyllous., perennials, ca. 0.5–1.5 m high, erect, branched, stems glabrous or minutely brown puberulent. *Leaves* petiolate, blades ca.4–20 by 2–10 cm, ovate to obovate, base attenuate, apex acute, margin serrate, lateral nerves 7–9 pairs, glabrous or abaxially minutely puberulent along veins; petioles ca.0.5–5 cm long. *Inflorescence* terminal or axillary, bracteate spikes, ca. 1–6 cm, peduncle ca. 1–12 cm, bracts leaflike, petiolate, oblanceolate, obovate, or spatulate, 1–2 cm, basally usually sterile, bracteoles linear-oblanceolate, 2–3 mm, deciduous before bracts. *Calyx* 5-lobed, ca. 0.2-0.3 cm flower, accrescent to ca. 2.5 cm in fruit, minutely puberulent, almost to base. *Corolla* purple, 3.5–5 cm, straight to slightly bent, outside glabrous, tube basally cylindric then slightly curved and gradually widened to ca. 1.5 cm at mouth, lobes oblong, subequal. *Stamen* 4, didynamous, filaments ca. 1.2-1.5 cm, glabrous. *Ovary* comose, style ca. 2.5 cm long,

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glabrous. *Capsule* 1.5–2.2 cm, glabrous. *Seeds* 4-seeded. Seeds ovate in outline, ca. 3.5 mm, covered with appressed trichomes.

Thailand.— NORTHERN: Chiengmai, Phayao; EASTERN: Loei.

Distribution.— China, India, Indo-China, and , and Myanmar.

Ecology.— Opened, dry evergreen forst.

Vernacular.— ว่านเครือออน (Wan khruea on) (Chiang Mai).

Conservation Status.— Vulnerable (by author).

23. **Strobilanthes fragrans** J.R.I. Wood, Kew Bull. 64(1): 36. 2009.

Shrubs, slightly anisophyllous, ca. 1–2 m high, presently leafless when flowering, all part reported to be strongly fragant, densely tomentose with reddish hairs. *Leaves* slightly unequal, petiolate, blades ca. 4–18× 2.5–10 cm, elliptic to oblong-elliptic, base acuminate, attenuate and slightly asymmetric, apex acute, margin undulate, lateral nerves 7–9 pairs, glabrous or abaxially minutely puberulent along veins; petioles 0.5–5 cm long. *Inflorescence* short spikes, terminal or axillary, ca. 1–4 cm, occationally reduced to a single pedunculate, bracts oblong-lanceolate, obtuse, persistent, bracteoles linear-oblanceolate, ca 0.4 cm long, persistent. *Calyx* 5-lobed, subequally, ca. 0.4 cm, lobes narrowly lanceolate, obtuse, glandular-pilose with white egandular hairs. *Corolla* purple, ca. 2.5 cm, straight to slightly bent, outside glabrous, tube basally cylindric then slightly curved and gradually widened to ca. 1.5 cm at mouth; lobes oblong, subequal. *Stamen* 4, didynamous, filaments glabrous. *Ovary* pubescent, style glabrous. *Capsule* oblong, ca. 1 cm, glabrous. *Seeds* 2-seeded.

Thailand.— NORTHERN: Nakhon Sawan.

Ecology.— Limestone hill.

Note:— all parts strongly fragrant, presently leafless.

Conservation Status.— Endanger (Wood and Scotland, 2009).

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24. **Strobilanthes glaucescens** Nees, Wall. Pl. As. Rar. iii. 85, cat. no. 7155; Nees in DC. Prodr. xi. 178. 1847.— *Ruellia glaucescens* Wall. Cat. No. 7155, Pl. Asiat. Rar. 3: 85. 1832.— *Hemigraphis glaucescens* (Wall. ex Nees) C. B. Clarke in Hook. f. Fl. Brit. Ind. Iv 425. 1884; R. Ben. In Lec. Fl. Gen. Ind. Ch. iv 655. 1935.— *Sericocalyx glaucescens* (Nees) Brem., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2 41(1): 163. 1944. (**Apendix Figure 7A**; **15A**)

Shrub, isophyllous, ca. 50-100 cm high, branchlets, pubescent. *Leaves* petiolate, blades ca. 5-15 by 3-5 cm, oblong or oblong-lanceolate, base attenuate, apex acuminate to acute, margin crenulate, lateral nerves 8-10 pairs, lineolate, setulose above, softly pubescent below; petioles ca. 1-3 cm long. *Inflorescence* spikes, terminal and axillary, dense, strobilate, ca. 3-8 cm long, bracts 4-ranked, ovate or oblong, acuminate to apex, ca. 1.5 by 1 cm, lineolate, hairy. *Calyx* 5-lobed, ca. 1 cm long, hairy outside, lobes 3-posterior and 2-anterior, connate at base. *Corolla* pinkish with purple lines, 2-3 cm long, puberulous outside, tube straight, venticose upward, lobes subequal, rounded. *Stamen* 4, didynamous, densely white hairy. *Ovary* glandular-hairy. *Capsule* ca. 0.8-1 cm long. *Seeds* 8-seeded.

Thailand.— NORTHERN:Mae Hong Son, Chiang Mai, Chiang Rai, Lampang; NORTH-EASTERN: Loei, Sakon Nakhon, Khon Kaen; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Uthai Thani; Central: Saraburi; PENINSULAR: Krabi.

Distribution.— Pegu! Tenasserim! and Myanmar.

Ecology.— In mixed forest, 600-1,000 m.

25. **Strobilanthes hamiltoniana** (Steud.) Bosser & Heine, Bull. Mus. Natl. Hist. Nat., B, Adansonia, Bot. Phyt. 10: 148. 1988.—*Ruellia hamiltoniana* Steud., Nom. Bot. edit. Sec. 2: 481. 1841.—*S. colorata* Nees, Com. Bot. Maga. 2: 312. 1837. — *S. colorata* (Nees) T. Anderson, J. Linn. Soc., Bot. 9: 481 1867.—*Diflugossa colorata* (Nees) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect.41(1): 237. 1944. (**Apendix Figure 7B**)

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Shrubs, anisophyllous, ca. 50-100 cm high, branchlets, stem quadrangular, sulcalte, glabrescent. *Leaves* petiolate or sessile, blades ca. 5-15 by 3-5 cm, oblong or oblong-lanceolate, smaller 2/3 sized of larger blade, base attenuate, apex acuminate to acute, margin entire or serrulate, lateral nerves 8-10 pairs, glabrous; petioles ca.0.5-5 cm long. *Inflorescence* panicle, terminal and axillary, ca. 10-30 cm long,much branched, rachis angled at ca. 60º, bracts broadlyovate, acuminate to apex, ca. 0.5 by 0.2 cm, glabrous, bracteoles oblanceolate to narrow elliptic, ca. 0.3 by 0.1 cm, concave, caducous, glabrous. *Calyx* 5-lobed, ca. 1 cm long, accrescent to ca. 1.2 cm in fruit, glabrous, sometimes apically gland tipped pubescent, suequally lobes, connated at base. *Corolla* pink, ca. 4-5 cm long, glabrous, tube straight, venticose upward, lobes equal, rounded. *Stamen* 4, didynamous, glabrous. *Ovary* pubescent, style ca. 3 cm. *Capsule* fusiform, ca. 1-1.5 cm long. *Seeds* 4-seeded.

Thailand.— CENTRAL: Nakhon Nayok.

Distribution.— China, India, Bhutan, Nepal and Mynmar.

Ecology.— Cultivated plant.

Vernacular.— ฮ้อม ทวีทรัพย์ (Hom Thaweesup) (Bangkok)

26. **Strobilanthes helferi** T. Anderson, J. Linn. Soc., Bot. 9: 472. 1867. (**Appendix figure 15B**)

Subshrub, slightly anisophyllous, plietesial, ca. 0.5–2 m tall, much branched, Stems quadrangular, hirsute. *Leaves* petiolate, blades ca. 10–15 by 8-10 cm, ovate, base cordate, apex caudate, margin entire to crenate, lateral nerves 6–8 pairs, sparsely pilose on bothside; petioles ca. 0.5-1 cm long, glabrous. Inflorescences very long flexuose flowers spikes, which have distant flowers pairs. bracts sessile, ovate, ca. 1.5–2 by 1-1.5 cm, broadly ovate to obovate-spatulate, ca.0.4–1 cm. *Calyx* 5-lobed, ca. 0.5–1.2 cm, unequal with 2 slightly shorter than others, margin usually ciliate, apex subacute. *Corolla* purple, funnel-shaped, ca. 2.5 cm, glabrous, tube basally cylindric and narrow for ca. 0.3 cm then slightly to strongly bent, abruptly inflated, and widened at mouth, lobes ca. 0.3-0.5 cm. *Stamens* 4, didynamous, filaments

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glabrous, ca. 0.2-0.4 cm. *Ovary* glabrous, style ca. 2 cm, glabrous. *Capsule* oblong, ca.0.6 cm, glabrous, *Seeds* 4-seeded.

Thailand.— NORTHERN: Tak; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Ranong .

Distribution.— Myanmar.

Ecology.— Limestone hill.

Conservation Status.— Insufficient data but probably vulnerable (Wood and Scotland, 2009).

Note.— *S. helferi* is distinguished by very long, flexuose flowers spikes.

27. **Strobilanthes heliophila** J.R.I. Wood, Kew Bull. 58(1): 98. 2003. (**Appendix figure 15C**)

Herb, strongly anisophyllous, ca. 30-50 cm high, stems subterete, hirsute. *Leaves* petiolate,unequal, blades ca. 1–8 by 1–5 cm, rhombic or ovate, base obtuse or rounded, apex acuminate, margin entire, ciliates, lateral nerves 6–7 pairs, sparsely pilose on bothside; petioles ca. 0.5-1 cm long, pubescent. Inflorescences spikes, terminal, 3–10 cm, flowers arranged in opposite pairs, distant, pilose, bracts sessile broadly ovate, ca. 0.8–2 by 0.5-1.5 cm, pilose and ciliate margin, bracteoles absent. *Calyx* 5-lobed, ca. 0.3–0.5 cm, gland-tipped pilose, almost to base, lobes linear, unequal with 2 slightly shorter than others, margin usually ciliate, apex subacute. *Corolla* purple, funnel-shaped, ca. 2.5–3 cm, glabrous, tube basally cylindric and narrow for ca. 0.3 cm then venticose upward, lobes rounded. *Stamens* 4, didynamous, filaments glabrous, ca.0.2-0.4 cm. *Ovary* glabrous, style ca. 2.5 cm. *Capsule* not seen.

Thailand.— PENINSULAR: Ranong, Pangnga.

Distribution.— Myanmar.

Ecology.— Opened, rocky, grassy places on ridge tops, 650-1,300 m.

Conservation Status.— Insufficient data but probably vulnerable (Wood and Scotland, 2009).

Note.— *S. heliphila* is closed to *S. auriculata* and *S. heferi*

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28. **Strobilanthes hispidula** (Craib) P. Charoenchai, unpublished.— *Hemigraphis hispidula* Craib in Bull. Misc. Inform. Kew 1913: 203. 1913; Ridley Fl. Mal. Pen. 2: 569.1923; R. Ben. In Lac. Fl. Gen. Ind. Ch. 4: 658. 1935.— *H, ridleyi* C.B. Clarke in Journ. As. Soc. Beng. 124: 652. 1908.

Herbs, anisophyllous, perennials, ca. 10-50 cm high, branchlets rooting at lower nodes, hairy and rigid, young parts mare densely covered with white hairs. *Leaves* petiolate, subequal, blades ca. 2.5-6 by 2-3.5 cm, ovate-lanceolate or ovate, base cuneate, apex sub-obtuse or rounded, margin crenate or crente-serrate, lateral nerves 5-6 pairs, lineolate, glabrous; petioles ca. 2 cm long. *Inflorescence* flowers 2-3 together in shortly peduncled small axillary heads, peduncle ca. 1 cm long, bracts oblong-ovate, narrowed at base, rounded apex, ca. 1 cm, margin crenulate or ciliate, bracteole linear ca. 0.6 cm, ciliate. *Calyx* 5-lobed, subequal, ca. 0.6 cm long, ciliate, connate at base.*Corolla* whitish purple, ca.1.5 cm long, glabrous, tube narrow at base, venticose upward, lobes equal, rounded. *Stamen* 4, didynamous, glabrous. *Ovary* pubescent, style ca. 1.2 cm. *Capsule* fusiform, ca. 0.8 cm long. *Seeds* 8-seeded.

Thailand.— NORTHERN: Nan, Lampang.
Ecology.— Dry evergreen forest.
Conservation status.— Vulnerable (by author).

29. **Strobilanthes hossei** C.B. Clarke, Bot. Jahrb. Syst. Bot. Jahrb. Syst.41: 67. 1907. —*S. rufohirtus* C.B. Clarke ex W.W. Sm. Notes Roy. Bot. Gard. Edinburgh.10 (49–50): 199. 1918.—*Pyrrothrix rufohirta* (C.B. Clarke ex W.W. Sm.) C.Y. Wu & C.C. Hu.—*S. fulvihispida* D. Fang & H.S. Lo Guihaia 17(1): 37. 1997.—*P. hossei* (C.B. Clarke) C.Y. Wu & C.C. Hu, F. Reip. Pop. Sin. 70: 155. 2002. (**Appendix figure 15D**)

Herb, isophyllous, perennials, ca. 30-50 cm high, erect, branched, stems quadrangular, pilose with light brown hairs. *Leaves* petiolate, subequal, blades ca. 5–11 by 2–5 cm, elliptic,base attenuate, apex acute, margin crenate, ciliate, lateral nerves 6–8 pairs, sparingly hairs above and densely below; petioles ca. 0.5–5 cm long.

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Inflorescence spikes, small, terminal or axillary, ca. 1–2 cm, peduncle 2–4 cm, densely light brown hairy, bracts spathulate-ovate ca. 1 by 0.5 cm, pilose, margin ciliate, bracteoles linear, ca. 0.5 by 0.2 cm, margin grlandular ciliate. *Calyx* 5-lobed, ca. 0.6-0.8 cm, minutely puberulent, subequal, united near to base. *Corolla* plae purple, ca. 3.5–4 cm, glabrous, tube basally cylindric then veticose upward, lobes rounded, subequal. *Stamen* 4, didynamous, filaments ca. 0.2-0.6 cm, pilose near base. *Ovary* glandular pubescent upwards, ca. 3 cm long. *Capsule* ca. 1 cm, pubescent. *Seeds* 4-seeded. Seeds covered with appressed light brown trichomes.

Thailand.— NORTHERN: Chiang Mai; NORTH-EASTERN: Loei; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Nakhon Si Thammarat, Satun .

Distribution. — China, Indo-China, Myanmar, Indonesia and Malaysia.

Ecology.— In evergreen forest.

Conservation status.— Vulnerable (by author).

30. **Strobilanthes imbricata** Nees, Pl. Asiat. Rar. (Wall.). 3:86. 1832; Wall. Cat. 7156; Nees in DC. Prodr. 11:186. 1847; T. Anderson In Journ. Linn. Soc. 9: 473. 1867; C. C. Clarke in Hook.f. Fl. Brit. Ind. 4: 455. 1884; Craib in Kew Bull. 436. 1911.—*S. perocaulis* Kurz in Journ. As. Soc. Beng. 42:93. 1873.—*Parasympagis garrettii* Brem., Kew Bull. 8(4): 565. 1954. (**Apendix Figure 7C; 16A**)

Shrubs, isophyllous or weakly anisophyllous, ca. 50-150 cm high, stem quadrangular, swollen above the nodes, hisute and then glabous. *Leaves* petiolate, blades ca. 2-8 by 2-5 cm, elliptic-lanceolate or ovat-elliptic, base attenuate and decurrent onto petioles, apex acuminate to acute, lineolate, margin entire, lateral nerves 5-10 pairs, hairy on both surfaces; petioles ca. 0.5-2 cm long. *Inflorescence* spikes, axillary or terminal, densely, strobiliform, ca. 2 cm long, shortly pedunculate, sometime solitary or forming loose small panicles, bracts imbricated, obovate, obtuse, ca. 0.8 by 0.25 cm, densely long ciliate, bracteoles linear-spatulate, ca. 0.3 cm. *Calyx* 5-lobed, subequal, ca. 0.5 cm, hirsute. *Corolla* white, sparingly hairy, ca. 1-1.5 cm, tube ca. 0.2 cm then venticose upward, lobes recurved. *Stamen* 4, didynamous, ca.

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0.5-0.6 cm, filament exserted. *Ovary* pilose at the apex, style ca. 1.2 cm, glabrous. *Capsule* oblong, ca. 0.5 cm, pubescent. *Seeds* 4-seeded.

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Uttaradit; NORTH-EASTERN: Phetchabun, Loei; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Narathiwat.

Distribution: — Myanmar.

Ecology.— In evergreen forest.

31. **Strobilanthes karensium** Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42(2): 94. 1873.—*S. lilacinus* C.B.Clarke -- Bot. Jahrb. Syst. 41(2): 67. 1908. (**Apendix Figure 7D**)

Subshrub, anisophyllous, ca. 100-150 cm high, stem quadrangular, young part with white hispid. *Leaves* petiolate, subequal, blades ca. 3-8 by 2-5 cm, ovate, base obtuse, apex acuminate, margin dentate, lateral nerves 8-9 pairs, lineolate, densely roughly pilose on both surfaces; petioles ca. 1.5-2 cm long. *Inflorescence* short spikes, axillary or terminal, bracts oblong obtuse or rounded at apex, ca. 1.5-2 cm, persistent, bracteoles lanceolate. *Calyx* 5- lobed, appressed hairy at the base, hairy towards the apex, ca. 1 cm, lobes linear-oblong united at base. *Corolla* purple, puberulous outside, ca. 3.5-4 cm long, tube ca. 0.5 cm, venticose upward. *Stamen* 4, didynamous, ca. 0.2-0.8 cm long. *Ovary* hairy, ca. 2.5 cm, style hairy.*Capsule* hairy, *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai; NORTH-EASTERN: Loei.

Ecology.— Opened, rock ground.

Conservation status.— Vulnerable (by author).

32. **Strobilanthes lanceifolia** T. Anderson., J. Linn. Soc., Bot. 9: 480. 1867; C.B. Clarke in Hook.f. Fl. Brit. Ind. 4: 465. 1884.—*S. lanceifolius* var. *laxior* Ridley in Journ. Fed. Mal. Mus. 10: 105. 1920. (**Appendix figure 16B**)

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Shrub, isophyllous, ca. 100- 150 cm high, stems obtusely quadrangular becoming terete, glabrous. *Leaves* petiolate, blades ca. 5-15 by 3-6 cm, elliptic or oblong-elliptic, base cuneate to attenuate, apex acuminate to acut, margin entire, lateral nerves 5-8 pairs, gabrous; petioles 1.5-3 cm long, glabrous. *Inflorescence* interrupted spikes, or terminal panicle, ca. 10-15 cm, glandular-pubescent, bracts oblong, obtuse apex ca. 0.5 cm, margin ciliate, bracteoles linear-oblong, ca. 0.4 cm. *Calyx* 5-lobed, ca. 0.8-1 cm, pubescent, subequally lobes. *Corolla* purple, glandular-pubescent outside in buds then becoming puberulous, ca. 3.5-4.5 cm, tube straight ca. 0.5 cm, venticose upward, lobes rounded. *Stamen* 4, didynamous, filament pilose, ca. 0.4-0.8 cm. *Ovary* pubescent, style ca. 2.5 cm, glabrous. *Capsule* oblong, ca.1.5 cm, pubescent at apex. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Nan; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chanthaburi; PENINSULAR: Chumphon, Ranong, Trang, Satun, Yala.

Distribution. — Myanmar.

Ecology.— Disturbed area, mixed forest, limestone hill.

Vernacular.— ช้าดูกกบ (Cha Dok Kob) (Chanthaburi).

33. **Strobilanthes maxwellii** J.R.I. Wood, Kew Bull. 58(1): 103. 2003. (**Apendix Figure 8A; 16C**)

Shurb, isophyllous, ca. 1.5-3 m high, stems terete, sulcate above, glabrous. *Leaves* petiolate, suequal, blades ca. 2.5-15 by 1-8 cm, elliptic or oblong-elliptic, base attenuate, apex acuminate, margin entire, lateral nerves 5-7 pairs, glabrous; petioles ca. 0.3-4 cm long, scabrous-pubescent. *Inflorescence* pedunculate axillary heads, ca. 3-5 cm long, a single peduncle arising from one axil of each leaf pair, peduncles ca. 2-7 cm long, glandular-pilose, bracts oblong or oblong-oblanceolate, acute, densely sticky glandular-pilose, ca.1.2-2.4 by 2-4 cm, bracteoles linear-oblong, ca. 1-1.5 by 0.2 cm. *Calyx* 5-lobed, ca. 0.8-1 cm, sparsely glandular-pilose and ciliate, subequally lobes, two lower slightly longer than three upper, narrow ovate. *Corolla* pale purple, glabrous outside, ca. 4 cm long, tube straight ca. 0.5 cm, venticose upward, lobes

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rounded. *Stamen* 4, didynamous, filament glabrous, ca. 0.4-0.8 cm. *Ovary* pubescent, style ca. 2.5 cm, glabrous. *Capsule* oblong, ca. 1.5 cm, glabrous. *Seeds* 4-seeded.

Thailand. — SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Ranong .

Ecology.—Disturbed area in mixed forest, 300 and 1,050 m.

Conservation Status.—Vulnerable (by author).

34. **Strobilanthes microcarpa** T. Anderson, J. Linn. Soc., Bot.9: 482. 1867. (**Appendix figure 17C**)

Shurb, isophyllous, ca. 1.5-3 m high, stems terete, often grooved at first, glabrous. *Leaves* presented leafless in flowering and fruiting. *Inflorescence* panicle, axillary and terminal, the lateral braches with numerous small axillary spikes, ca. 10-12 cm long, flower sessile, mostly opposite, distant, peduncle with numerous glandular hairs, bracts linear-lanceolate, acute, caducous falling off when flower open, ose, ca.1.2-2.4 by 2-4 cm, bracteoles absent. *Calyx* 5-lobed, ca. 0.8-1 cm, sparsely glandular-pilose and ciliate, subequally lobes, two lower slightly longer than three upper, narrow ovate, accrescent twice in fruit. *Corolla* white, glabrous outside, ca. 0.2-0.4 cm long, tube straight ca. 0.5 cm, venticose upward, lobes rounded. *Stamen* 4, didynamous, filament glabrous, ca. 0.4-0.8 cm. *Ovary* glabrous, style ca. 1.5 cm, glabrous. *Capsule* fusiform, ca. 0.8 cm, glabrous, flattened. *Seeds* 4-seeded.

Thailand.— SOUTH-WESTERN: Kanchanaburi.

Distribution.— Myanmar.

Ecology.— In evergreen forest.

Conservation Status.— Vulnerable (by author).

35. **Strobilanthes moschifera** Blume, Bijdr. Fl. Ned. Ind. 14: 800. 1826.— *S. debilis* C. B. Clarke, J. Linn. Soc., Bot. 26(175): 239. 1890.—*Adenostachya moschifera* (Blume) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2.2. Amsterdam 41(1): 191. 1944. (**Appendix figure 16D**)

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Shrub, isophyllous, ca. 20-30 cm high, creeping and rooting at nodes, stem subterete, pubescent. *Leaves* petiolate, unequal, blades 2-8 by1.5-2.5 cm, elliptic, base attenuate, apex acute, margin entire, lateral nerves 5-6 pairs, minutely pubescent; petioles ca. 0.5 cm, pubescent. *Inflorescence* spikes, terminal or axillary, small, interrupted, ca. 5-8 cm long, hairy, bracts linear-lanceolate, acuminate, ca. 0.8 by 0.2 cm, glandular-hairy, margin ciliate, bracteoles, linear, ca. 0.5 cm, margin ciliate. *Calyx* 5-lobed, subequal, ca. 0.5-0.8 cm long, margin pillous, grandulous. *Corolla* purple, ca.2 .5 cm, tube ca. 0.4 cm, venticose upward, lobes rounded. *Stamen* 4, didynamous, ca. 0.5-1.5 cm, glabrous. *Ovary* shortly glandulous, style ca. 1.2 cm, glabrous. *Capsule* not seen.

Thailand.— SOUTH-EASTERN: Chanthaburi

Ecology.— In evergreen forest, 20 m.

Vernacular.— พวงเหนียว (Phung Neaw).

Conservation Status.— Vulnerable (by author).

36. **Strobilanthes palawanensis** Elmer, Leafl. Philipp. Bot. v. 1686. 1913.— *Glodfussia palawanensis* (Elm.) Brem., Verh. Akad.Wet., Afd. Nat. sect. 2. 41(1): 232. 1944.— *Hymenochlaena palanwanensis* (Elm.) Brem., Philip. Journ. Sc. 80: 11. 1952.— *S. ranongensis* Terao, Acta Phytotax. Geobot. 64:4-6, 1983.

Shrub, isophyllous, ca. 100-200 cm high, stem subterete, glabrous. *Leaves* petiolate, unequal, blades ca. 5-15 by 1.5-5.5 cm, oblong-lanceolate, base attenuate apex acuminate, margin entire or sub-crenate, lateral nerves 6-8 pairs, pubescent; petioles ca. 0.5 cm long, pubescent. *Inflorescence* spikes, terminal or axillary, strobiliform elongate 4-8 cm long, peduncle 2-3 cm long, bracts densely imbricate, oblong-elliptic, cuspidate apex, attenuate at base, bracteoles, subulate, ca. 0.5 cm, margin pillous, glandulous. *Calyx* 5-lobed, ca. 0.5-0.8 cm long, margin pillous, grandulous. *Corolla* whitish purple, ca. 1.3-1.5 cm, tube ca. 0.2 cm, venticose upward, 5-lobes. *Stamen* 2, didynamous, ca. 0.3 cm, pubescent. *Ovary* glandulous, pubescent. *Capsule* calvate, ca. 1 cm, pubescent. *Seeds* 4-seeded.

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Thailand.— PENINSULAR: Chumphon, Nakhon Sitammarat.

Distribution.— Singapore and Philippines.

Ecology.— Moisted, tropical rain forest.

Conservation Status.— Vulnerable (by author).

37. **Strobilanthes paniculata** T. Anderson, J. Linn. Soc., Bot. 9: 483. 1867. —*S. subcapitatus* (*S. subcapitata*) C.B. Clarke; Fl. Brit. India 4: 455. 1884. (**Apendix Figure 8B; 17A**)

Shrub, isophyllous, ca. 80 cm high, stem quagranular, obtuse, slender, glabrous. *Leaves* petiolate, unequal, blades ca. 5-14 by 2.5-5.5 cm, elliptic or ovate-elliptic, base obtuse or attenuate, apex acuminate to acute, margin entire, lateral nerves 5-8 pairs, glabrous; petioles ca. 0.5-1.5 cm long, glabrous. *Inflorescence* spikes, very small ovoid or ellipsoid, strobiliform, terminal or axillary, ca. 1-1.2 cm long, peduncle 2-3 cm long, often divided and bearing reduced leaves, bracts obovate, apex rounded, concave, ca.0.5 by 0.3 cm, glabrous, margin ciliate, bracteoles, linear-obovate, ca. 0.5 by 0.2 cm, margin ciliate. *Calyx* 5-lobed, ca. 0.5-0.8 cm long, glabrous, subequally lobes, margin ciliate. *Corolla* whitish purple, ca. 1.3-1.5 cm, glabrous, tube ca. 0.2 cm then venticose upward. *Stamen* 4, didynamous, ca. 0.3-0.5 cm, glabrous. *Ovary* pubescent at apex, style ca. 1 cm, glabrous. *Capsule* oblong, ca. 0.6-0.8 cm, pubescent. *Seeds* 4-seeded.

Thailand.— PENINSULAR: Chumphon, Ranong.

Ecology.— Moisted, tropical rain forest.

Conservation Status.— Vulnerable (by author).

38. **Strobilanthes pateriformis** Lindau, Bull. Herb. Boissier, 5: 653. 1897. —*S. alatiramosa* H.S. Lo & D. Fang, Guihaia 17(1): 29. 1997.—*Pteracanthus alatiramosus* (H.S. Lo & D. Fang) C.Y. Wu & C.C. Hu, The record derives from www. Tropicos. org (data supplied on 2555-04-18).—*Pteroptychia pateriformis* (Lindau) Bremek., The record derives from www. Tropicos. org (data supplied on 2555-04-18). (**Apendix Figure 8C**; **17B**)

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Shrub, anisophyllous, ca.100-150 m high, stem glabrous with winged, wing 0.2-0.5 cm. *Leaves* petiolate, smaller blade ca. 2-8 by 2-4 cm and larger blade ca. 6-15by 3-6 cm, oblong-ovate to lanceolate, base cuneate and decurrent onto petiole, apex acute, margin dentate to crenate, lateral nerves 4-6 pairs, glabrous; petioles ca. 0.5-2.5 cm long. *Inflorescence* spikes, terminal or axillary, ca. 5-10 cm long, bracts ovate-lanceolate, ca. 0.4 cm, glabrous, bracteoles spatulate-linear, ca. 0.5 cm, caducous, glabrous. *Calyx* 5-lobed, glabrous, ca. 1 cm, subequally lobes. *Corolla* whitish purple, ca. 3-5 cm long, tube ca. 0.3 cm, venticose upward, ovate, subequal. *Stamen* 4, didynamous, filament hirsute. *Ovary* pubescent, ca. 2.5 cm. *Capsule* oblong-elliptic, ca. 1.2-1.4 cm long. *Seeds* 4-seeded.

Thailand.— NORTHERN: Nan, Phitsanulok; NORTH-EASTERN: Loei; SOUTH-EASTERN: Chantabun; PENINSULAR: Pattani.

Distribution.— China, Laos, Vietnam and Indenesia.

Ecology.— In evergreen forest.

Note.— Winged on branches and inflorescence is the distinguish character.

39. **Strobilanthes pedunculosa** Miq. Fl. Ned. Ind. 2: 803.— *Lissospermum pedunculosum* (Miq.) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41(1): 302. 1944.

Shrub, strongly anisophyllous, 100-150 cm high, stem quadrangular, glabrous. *Leaves* sessile or subsessile, subequal, blades ca. 3-8 by 2-5 cm, ovate or oblong-lanceolate, base rounded or creneat, apex acuminate to subacute, margin entire, lateral nerves 6-7 pairs, glabrous. *Inflorescence* raceme, axillary and terminal or lateral, simple or branched, lax, flowers distant, alternate, pedicel 1-1.2 cm, glandular pubescent, bracts persistent, linear-oblong, ca. 0.5 cm, bracteoles lanceolate. *Calyx* 5-lobed, subequal, appressed hairy at the base, hairy towards the apex, ca. 1-1.2 cm, lobes linear-oblong united at base. *Corolla* purple, puberulous outside, ca. 3.5-4 cm long, tube ca. 0.5 cm, venticose upward. *Stamen* 4, didynamous, ca. 0.2-0.6 cm long. *Ovary* glabrous, ca. 2.6 cm, style hairy. *Capsule* hairy, *Seeds* 4-seeded.

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Thailand.— SOUTH-WESTERN: Kanchanaburi.

Ecology.— Seasonal evergreen forest.

Conservation Status.— Vulnerable (by author).

Note.— This plant collected by J. F. Maxwell in 2003, with named *S. microcarpa*, very different in zigzaged-fructescence and stout capsules with long persistent calyx.

40. **Strobilanthes quadrifaria** (Wall. ex Nees) Y.F. Deng, Act. Phyto. Sin. 45(6): 849–850, f. 1. 2007.—*Ruellia quadrifaria* Wall. ex Nees , Plantae Asiaticae Rariores 3: 83. 1832.—*Hemigraphis quadrifaria* (Wall. ex Nees) T. Anderson, Journal of the Linnean Society, Botany 9: 463. 1867.—*Sericocalyx quadrifarius* (Wall. ex Nees) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 41(1): 163. 1944. (**Apendix Figure 8D; 17D**)

Herb or shrub, isophyllous, ca. 0.5-1 m high, branchlets woody, hispid-hirsute with white or yellow hairs. *Leaves* petiolate, blades ca. 5-12 by 2.5-5 cm, ovate, ovate-elliptic, base attenuate, apex acute, margin crenulate, ciliate, lateral nerves 8-10 pairs, densely hairy; petioles ca. 1-2 cm long, hirsute. *Inflorescence* spikes axillary and terminal, simple, strobiliform, hirsute, ca. 4-8 cm long, peduncle ca. 1-2 cm long, bracts 4-sided, imbricated, ovate-lanceolate or oblong, subacute, ca. 2 by 1 cm, densely hirsute on bothsides, margin minutely crenulate or subentire, ciliate, bracteoles linear, acute, shorter than the calyx, ca. 0.2-0.5 cm, hairy. *Calyx* 5-lobed, ca.1-1.2 cm long, hirsute outside, lobes linear-lanceolate acuminate, hairy. *Corolla* pale purple or pale pink, puberulous outside, ca. 2.5-3.5 cm long, lobe tube curved, ventricose upward, lobes subequal, round, ca. 0.4-0.5 cm long. *Stamen* 4, didynamous, filament hairy, anther oblong, muticous. *Pollen* prolate, 3-colporate, P=62.31±1.17, E=38.46±1.25, P/E=1.62, 16-18 pseudocolpi, 18-20 ribs,ribs with coarsely reticulate tectum. (**Apendix Figure 34**) *Ovary* hairy. *Capsule* oblong. *Seeds* 8-16 seeded.

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Thailand.— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Phayao, Lampang, Phrae, Kamphaeng Phet; NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Uthai Thani, Kanchanaburi.

Distribution.— China, Laos and Myanmar.

Ecology.— In open forest.

Vernacular.— ตีนตั่งเตี้ย (Tin tang tia), สตีน้ำ (Sati nam) (Loei), ฮอมดง (Hom dong) (Chiang Mai).

41. **Strobilanthes repanda** (Blume) J.R. Bennett, Kew Bull. 58(1): 56. 2003.— *Lepidagathis repanda* Blume Bijdr. Fl. Ned. Ind. 14: 802. 1826.—*S. rubroglandulosa* Craib, Bull. Misc. Kew 1912: 268. 1912. (**Apendix Figure 9B**; **18B**)

Herb, isophyllous, strangling, ca. 30-50cm high, stems terete, sulcate above, glabrous. *Leaves* petiolate, subequal or unequal in each pair, blades 2.5-10 by 2-4.5 cm, , ovate-lanceolate, base acuminate, apex cuneate, margin lobed, lateral nerves 4-5 pairs, glaucescent, petioles 0.5-1.5 cm long, glabrous. *Inflorescence* spikes, pedunculate axillary or teminal, ca. 3-5 cm long, a single peduncle arising from one axil of each leaf pair, peduncles 2-7 cm long, glandular-pilose, bracts oblong or oblong-oblanceolate, retuse at apexe, hairy, glandular-pilose, ca.0.8 by 0.3 cm, bracteoles but smaller, ca. 0.5 by0.2 cm. *Calyx* 5-lobed, subequally lobes, ca. 0.8-1.2 cm, two lower slightly longer than three upper, narrow ovate. sparsely glandular-pilose and ciliate. *Corolla* pale purple, glabrous outside, ca. 4 cm long, tube straight ca. 0.5 cm, venticose upward, lobes rounded. *Stamen* 4, didynamous, filament glabrous, ca. 0.4-0.8 cm. *Ovary* pubescent, style ca. 2.5 cm, glabrous.*Capsule* oblong, ca. 1.5 cm, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Phrae, Sukhothai; NORTH-EASTERN: Phetchabun; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chon Buri, Rayong.

Ecology.— Along stream in evergreen forest.

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42. **Strobilanthes reptans** (G. Forst.) Moylan ex Y.F. Deng & J.R.I. Wood, Flora of China 19: 390–391. 2011.—*R. reptans* G. Forst.,Fl. Ins. Austr. Prod. 44. 1786.—*Hemigraphis primulifolia* (Nees) Fern.-Vill., F. Filip. 4(13A): 153. 1880.—*Ruellia primulifolia* Nees, Nov. Act. Acad. Cae. Leop.-Carol. Nat. Cur.19 (Suppl. 1): 362. 1843.—*H. reptans* (G. Forst.) T. Anderson ex Hemsl.,Rep. Sci. Res. Voy. H. M. S. Cha. 1(3): 173. 1885.—*Hemigraphis okamotoi* Masam. Trans. Nat. Hist. Soc. Formosa 25: 248. 1935.—*H. pacifica* Hosok., Trans. Nat. His. Soc. Tai. 25: 127. 1935. (**Apendix Figure 9A**)

Herb, isophyllous, perennials, ca. 10-30 cm high, prostrate and rooting at nodes. *Leaves* petiolate, blades ca. 2-6 by1-4 cm, oblong, oblong-ovate or elliptic, base truncate to slightly cordate, apex acute to obtuse, margin entire to sub crenate, lateral nerves 3-5 pairs, pubescent with multicellular trichomes; petioles ca. 0.5-5 cm long. *Inflorescence* spikes, terminal, elongate ca. 5-8 cm long, bracts oblanceolate to elliptic, ca. 0.5-1 cm, persistent, margin entire and ciliate, bracteoles absent. *Calyx* 5-lobed, united near base, linear-lanceolate, ca.0.5-1 cm long, ciliate and pubescent along veins, attenuate at base. *Corolla* white with purple veins, ca. 1.2-1.8 cm, glbrous, tube ca.0.5 cm, expanded upward, 5-lobes, glabrous. *Stamen* 4, didymanous, ca. 0.3-0.5 cm, base slightly villous. *Ovary* pubescent, ca. 0.4 cm, style villous. *Capsule* oblong, ca. 0.8 cm long, pubescent. *Seeds* 8-16-seeded.

Thailand.— CENTRAL: Bangkok.

Distribution.— Japan, Taiwan, Malaysia, Indonesia, Philippines, Papua New Guinea, New Caledonia, Australia and Pacific islands

Ecology.— Invasive plant, disturbed places.

43. **Strobilanthes rivularis** J.R.I. Wood & J.R. Benn., Kew Bull. 58(1): 166. 2003. (**Appendix figure 18A**)

Herb, anisophyllous, perrnials, ca. 90 cm high, stem glabrous, sulcate. *Leaves* unequal in each pair, *Leaves* petiolate, blades ca. 3–10 by 1.2–4.8 cm, ovate to broadly elliptic, base attenuate, apex acute, margin serrate, lateral nerves 7–9 pairs,

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glabrous or abaxially minutely puberulent along veins; petioles ca. 0.3–2 cm long. *Inflorescence* spikes, terminal or axillary, ca. 1.5–2.5 cm, usually single spikes arising from each leaf axil, peduncle ca.1–4 cm, bracts glabrous, petiolate, obovate, obtuse, the lower most with recurved tips, pilose with long white glandular hairs, bracteoles linear-oblanceolate, ca. 0.4–0.5 cm, thiny, pilose. *Calyx* subequal, 5-lobed, ca. 0.5-0.6 by 0.2-0.3 cm long, oblong to obtuse, united almost to base. *Corolla* white, ca. 1.2 cm, straight to slightly bent, outside glabrous, tube basally cylindric then slightly curved and then venticose upward, lobes rounded, subequal. *Stamen* 4, didynamous, filaments ca. 0.5 cm, glabrous. *Ovary* glabrous, style ca. 0.8 cm long, glabrous. *Capsule* 1.5–2.2 cm, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai, Tak; PENINSULAR: Ranong.
Ecology.— Limestone hill with evergreen forest, open grassy slope.
Conservation Status.— Endanger (Wood and Scotland, 2009).

44. **Strobilanthes rufescens** (Roth) T. Anderson, J. Linn. Soc., Bot. 9: 472. 1867.— *R. rufescens* Roth, Nov. Pl. Sp. 304. 1821.— *Ruellia comosa* Roxb., Fl. Ind. 1832 3:43. 1832.— *Buteraea ulmifolia* Nees in Wall., Pl. Asiat. Rar. 3:84. 1832.— *B. rufescens* (Roth) D. Dietr., Syn. Pl. 3: 589. 1843.— *S. rufescens* var. *rubiginosa* C.B. Clarke in Hook. f., Fl. Brit. Ind. 4: 430. 1884.

Herb, isophyllous, perennials, ca. 0.5–1.5 m high, erect, branched, stems glabrous or minutely brown puberulent. *Leaves* petiolate, blades ca. 4–20 by 2–10 cm, elliptic to ovate, base attenuate, apex acute, margin serrate, lateral nerves 7–9 pairs, glabrous or abaxially minutely puberulent along veins; petioles ca. 0.5–5 cm long. *Inflorescence* bracteate spikes, terminal or axillary, ca.1–6 cm, often aggregated to form a leafy branched panicle, peduncle ca.1–12 cm, bracts leaflike, petiolate, oblanceolate, obovate-elliptic, basally usually sterile, bracteoles linear-oblanceolate, ca. 0.2–0.5 cm, deciduous before bracts. *Calyx* 5-lobed, ca. 0.2-0.3 cm, accrescent to ca. 2.5 cm in fruit, minutely puberulent, united almost to base. *Corolla* purple, ca. 3.5–5 cm, straight to slightly bent, outside glabrous, tube basally cylindric then slightly curved and venticose upward, lobes rounded, subequal. *Stamen* 4,

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didynamous, filament ca. 0.8-1 cm, glabrous. *Ovary* glabrous, style ca. 2.4 cm. *Capsule* ca. 1.5–2.2 cm, glabrous. *Seeds* 4-seeded. Seeds ovate, ca. 0.3-0.4 cm, covered with appressed trichomes.

KEY TO SUBSPECIES

1. Bracts oblong-oblanceolate, ca.0.7-1.4 cm long……..……..**44a.**subsp. **parishii**
1. Bracts obovate-elliptic, ca. 0.4-0.5 cm long……..……**44b.**subsp. **parvibracteata**

44a. **Strobilanthes rufescens** (Roth) T. Anderson subsp. **parishii** (C.B.Clarke) J.R.I. Wood, Kew Bull. 58(1): 88. 2003.— *S. foetidissima* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43: 93. 1873.— *S. parishii* C.B. Clarke in Hook. f., Fl. Brit. Ind. 4:431. 1884. (**Appendix figure 18C**)

Thailand.—NORTHERN: Mae Hong Son, Chiang Mai.

Distribution. — Myanmar.

Ecology.— In evergreen forest.

Note:— Plant covered with more reddish hairy.

44b. **Strobilanthes rufescens** (Roth) T. Anderson subsp. **parvibracteata** (Clarke) J.R.I. Wood, Kew Bull. 58(1): 88. 2003; —*Buteraea parvifolia* Bremek., Dansk Bot. Ark. 20: 70. 1961; —*S. parvibracteata* C.B.Clarke Bot. Tidsskr. 24: 349. 1902.

Thailand.—SOUTH-EASTERN: Trat.

Ecology.— Lowland in evergreen forest.

Conservation Status.— Insufficient data but possibly vulnerable (Wood and Scotland, 2009).

Note:—Restricted in chanthaburi and Trat Province.

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45. **Strobilanthes schomburgkii** (Craib) J.R.I. Wood**,** Kew Bull. 64(1): 46. 2009.
——*Hemigraphis schomburgkii* Craib Bull. Misc. Inform. Kew 1911: 435. 1911; R. Ben. In Lec. Fl. Gen. Ind. Ch. 4: 656. 1935. (**Apendix Figure 9C**)

Shrub, isophyllous, ca. 100-200 cm high, branchlets subquadrangular, lineolate, glabrous. *Leaves* petiolate, blades ca. 5-12 by 1.5-2.5 cm, oblong to lanceolate, base attenuate, apex acuminate to acute, margin entire, lateral nerves 6-7 pairs, rigidly chartaceous, lineolate and glabrous on both surface; petioles ca. 0.5-1 cm long. *Inflorescence* spikes, terminal and on short lateral branches, bracts ovate-lanceolate, subobtuse, ca. 1.2 by 0.6 cm, lineolate and puberulous on bothsides, bracteoles, small, lanceolate, acute, pilose. *Calyx* 5–lobed, ca. 1 by 0.5 cm, puberulous outside, lobes linear-lanceolate, subacute, appressed white-hairy inside, ciliate. *Corolla* whitish pink, with purple veins, ca. 2-3 cm long, short pilose outside, tube narrow and then venticose upward, lobes subequal, rounded. *Stamen* 4, didynamous, filament densely hairy, ca. 1.2-1.5 cm. *Pollen* prolate, 3-colporate, P=43.68±1.62, E=29.47±1.35, P/E=1.48, 12-14 pseudocolpi, 14-16 ribs, ribs with coarsely reticulate tectum. (**Apendix Figure 35**) *Ovary* glabrous, style ca. 1.8-2 cm. *Capsule* oblong, ca. 1 cm. glabrous. *Seeds* 8-seeded.

Thailand.—NORTHERN: Chiang Mai, Chiang Rai; NORTH-EASTERN: Phetchabun, Loei, Kalasin, Khon Kaen; EASTERN:Nakhon Ratchasima; CENTRAL: Saraburi, Bangkok, Samut Prakan; SOUTH-EASTERN: Chanthaburi; Peninsular: Songkla.

Distribution: —Indo-China.

Vernacular:—-ขาไก่ (Kha kai), แข้งไก่ (Khaeng kai) (Bangkok).

Ecology.—In evergreen forest.

Note:—commonly cultivated as a hedge plant.

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Figure 3 *Strobilanthes schomburgkii* (Craib) J.R.I. Wood; A. habit; B-C. flowers; D. longtitudinal section of flower; E-F. stamens; G. pistil.
Drawn by Sunti Saisuwan.

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46. **Strobilanthes serrata** J.B. Imlay**,** Bull. Misc. Inf. Kew 1939: 117. 1939. —*Gutzlaffia glandulosa* Lace,Bull. Misc. Inf. Kew 1915: 406. 1915. (**Apendix Figure 9D; 18D**)

Subshrubs, slightly isophyllous, perennials, ca. 50–100 m high, erect, stems sulcate, glabrous or with a few crisped trichomes. *Leaves* petiolate, blades ca. 5–15 by 4–8 cm, ovate to oblong-ovate, base gradually narrowed and then decurrent onto petiole, apex acuminate, margin coarsely serrate, lateral nerve 7–9 pairs, green variegated with white patches and glabrous; petioles ca. 0.5–7 cm long. *Inflorescence* from apical leaf axils, simple or branched pedunculate spikes, commonly forming a terminal panicle of spikes, ca. 2–7 cm, densely gland-tipped pilose, peduncle of panicles 2–10 cm, subglabrous to thinly pubescent, rachis and branches densely gland-tipped pilose, bracts oblong-ovate to oblong-obovate, persistent, densely gland-tipped pilose, apex obtuse; bracteoles oblong to obovate, densely gland-tipped pilose, flowers in opposite pairs, basally 1–2 cm apart on rachis, clearly separate all along spike except at very apex. *Calyx* 5-lobed, ca. 0.5–0.6 cm, subequally, oblong, acut apex, outside densely gland-tipped villous. *Corolla* purple with a white tube, ca. 2–2.6 cm, straight or slightly bent, outside sparsely to densely pilose with large-celled trichomes, lobes ovate, apex obtuse. *Stamen* 2, filaments, glabrous, *Ovary* villous, style, glabrous. *Capsule* oblong, pubescent. *Seeds* 4-seeded.

Thailand.—NORTHERN: Chiang Mai; NORTH-EASTERN: Loei.

Distribution. — China and Myanmar

Ecology.—Shaded moist places in evergreen forests.

Conservation Status.—Vulnerable (by author).

47. **Strobilanthes speciosa** Blume, Bijdr. Fl. Ned. Ind. 14: 799. 1826. —*Goldfussia speciosa* (Blume) Bremek. Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 227. 1944; —*S. kerrii* Craib Bull. Misc. Inform. Kew 1912: 267. 1912;—*S. pierrei* Benoist, Bull. Soc. Bot. France 80: 730. 1934 (**Apendix Figure 19A**)

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Herb or subshrub, anisophyllous, perennials, ca. 1.2 m high, stems ascending, apically pubescent. *Leaves* petiolate, subequal, smaller blade ca. 3 by 1.6 cm and larger blade ca. 12.5–16.5 by 6–8 cm, ovate to suborbicular, base oblique and decurrent onto petiole, apex acute to caudate, margin irregularly crenate or dentate, lateral nerves 7–9 pairs, both surfaces hirsute, adaxially with numerous prominent linear cystoliths; petioles ca. 0.5–2 cm long, hirsute. *Inflorescence* axillary, heads, narrowly ovoid, ca. 1–2.5 by 1–1.5 cm, borne on simple or 3-furcate branches; peduncle 1–3 cm, simple or branched and sometimes with a sterile bract at branching point, hirsute, sterile bracts resembling small leaves, floral bracts lanceolate, overtopping capitula, abaxially brownish pubescent with gland-tipped trichomes, margin entire and ciliate, apex acuminate and falcate, bracteoles oblanceolate, pilose, margin ciliate. *Calyx* 5-lobed, hirsute, almost to base, lobes oblanceolate, ca. 0.2 cm, subequal, margin ciliate, apex acute. *Corolla* Corolla purplish blue, 3.5–5 cm, ventricose, outside gland-tipped pilose, inside glabrous, tube basally cylindric and then venticose upward, lobes apex rounded. *Stamen* 4, didynamous, filaments glabrous. *Ovary* comose, style ca. 3 cm. *Capsule* fusiform, 1.5–1.8 cm, apically with a few gland-tipped trichomes. *Seeds* 4-seeded. ovate, appressed pilose.

Thailand.—NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Nan, Lamphun, Lampang, Tak, Sukhothai, Kamphaeng Phet; NORTH-EASTERN: Loei; EASTERN: Chaiyaphum; South-Western: Uthai Thani, Prachuap kiri khan; PENINSULAR: Nakhon Si Thammarat.

Distribution: —China, Indo-China, Indonesia and Malaysia

Ecology.—Evergreen forest.

48. **Strobilanthes tenuiflora** J.R.I. Wood**,** Kew Bulletin 58: 691. 2003. (**Apendix Figure 19B**)

Subshrub, anisophyllous, ca. 1.5 m high, stems quadrangular, sulcate, glabrous. *Leaves* petiolate, subequal, blades ca. 1–13 by 0.5–8 cm, ovate to ovate-elliptic, smaller blade 1/4–1/3 size of larger one, base obliqueand broadly cuneate, rounded or slightly cordate, apex acuminate margin slightly serrate to sub-entire,

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lateral nerves 5–7 pairs, glabrous except for multicellular trichomes in teeth sinuses, adaxially cystoliths prominent; petioles ca. 0.5–3 cm long. *Inflorescence* terminal, panicles, ca. 10-20 cm, peduncle to 3 cm, glabrous, rachis slender, glabrous, repeatedly 3-forked and bent to ca. 90º, bracts subulate, ca. 1 mm, caduceus, bracteoles similar to bracts. *Calyx* 5-lobed, ca. 0.4–0.6 cm, accrescent to ca. 1 cm in fruit, glabrous, almost to base, lobes oblong to oblong-lanceolate with one slightly longer than others, margin pale, apex emarginate. *Corolla* white, 3–4 cm, straight, glabrous, tube basally cylindric and then ventricose upward. *Stamen* 4, filaments glabrous. *Ovary* glabrous, style 0.2–0.3 cm, glabrous. *Capsule* oblong, ca. 1.5 cm, glabrous. *Seeds* 4-seeded.

Thailand.— NORTHERN: Chiang Mai; SOUTH-WESTERN:Kanchanaburi.
Distribution. — China.
Ecology.— In evergreen forest.
Conservation Status.— Vulnerable (by author).

49. **Strobilanthes tonkinensis** Lindau, Bull. Herb. Boissier 5: 651. 1897.
—*S.nivea* Craib, Bull. Misc. Inform. Kew 1914: 131. 1914. (**Apendix Figure 19C**)

Herb, isophyllous or weakly anisophyllous, ca. 50–100 cm high, stems quadrangular, glabrescent, fragrant when dry. *Leaves* petiolate, blades ca. 15-18 by 5-6 cm, broadly oblong-elliptic, base cuneate and decurrent onto petiole, apex acute, margin crenate, lateral nerves 4–7 pairs, both surfaces sparsely pubescent especially on veins, adaxially with prominent cystoliths; petioles ca. 2 cm long, *Inflorescence* simple spikes, terminal, ca. 3–11 cm long, sometimes with branches arising in apical leaf axils, rachis pubescent with gland-tipped trichomes, bracts linear-spatulate, ca. 1–1.5 by 0.2–0.3 cm, sparsely pubescent and gland-tipped pubescent, densely covered with white cystoliths, 1-veined, bracteoles linear, pubescent, densely covered with cystoliths. *Calyx* 5-lobed, lobes linear, 0.8–1 by 0.1 cm, subequal, pubescent, outside covered with prominent cystoliths. *Corolla* whitish pink, ca. 3 cm, straight, outside glabrous, inside glabrous except for trichomes retaining style, tube basally cylindric then venticose upward, lobes orbicular. *Stamen* 4, included, puberulent, anther thecae

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oblong. *Ovary* obovoid, gland-tipped pilose at tip, style ca. 1.5 cm, glabrous. *Capsule* narrowly oblong-obovoid, ca. 0.8–1 cm, glandtipped pilose. *Seeds* 4-seeded.

Thailand.—NORTHERN: Chiangmai, Lamphun; EASTERN: Nakhon Ratchasima; CENTRAL: Bangkok.

Distribution: — China and Vietnam.

Ecology.— In evergreen forest.

Conservation Status:— Vulnerable (by author).

Unplaced Species:

50. **Hemigraphis reganda** (L.) Hallier f., Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 70: 198. 1897; —*Ruellia repanda* L., Sp. Pl. ed. 2: 886. 1763. (**Apendix Figure 19D**)

Herb, hygrophilous or aquatic plant, isophyllous, ca. 5-15 cm high, prostrate and rooting at nodes. *Leaves* sessile or sub-petiolate, blades ca. 2-8 by 1-2 cm, oblong-elliptic, base attenuate, decurrent onto petioles, acute apex, margin undulate. lateral nerves 8-10 pairs, pubescent with multicellular trichomes; petioles 0-0.5 cm long. *Inflorescence* spikes, terminal, elongate 3-4 cm long, bracts oblanceolate to elliptic, ca. 0.5-1cm, persistent, margin entire and ciliate, bracteoles absent. *Calyx* 5-lobed, united near base, linear-lanceolate, ca.0.5-1 cm long, glabrous. *Corolla* white with purple veins, ca. 1.2-1.8 cm, glbrous, tube ca. 0.5 cm, expanded upward, 5-lobes, glabrous. *Stamen* 4, didymanous, ca. 3-4 mm, base slightly villous. *Ovary* pubescent, ca. 4 mm, style villous. *Capsule* oblong, ca. 0.8 cm long, pubescent. *Seeds* 8-16-seeded.

Thailand.— Central:Bangkok.

Distribution. — Malaya.

Ecology.— Hygrophilous or aqualtic plants.

Vernacular.—ริบบิ้นดำ (Rip bin dam) (Bangkok).

Note.— Introduced, cultivated plant .

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4. The biological activities of the subtribe *Ruelliinae* (Acanthaceae) in Thailand

Twenty plants (from eleven genera) in the family Acanthaceae were collected from many parts of Thailand. These plants include *Asystasia nemorum* Nees, *Barleria cristata* L., *B. strigosa* Willd., *Dicliptera burmanni* Nees, *Eranthemum tetragonum* Nees, *Hygrophila ringens* (L.) Steud., *Justicia balansae* Lindau, *J. procumbens* L., *Lepidagathis incurva* Buch.-Ham ex D.Don, *Peristrophe lanceolaria* (Roxb.) Nees, *Phaulopsis dorsiflora* (Retz.) Santapau, *Ruellia kerrii* Craib, *Strobilanthes auriculata* Bremek., *S. corrugata* Imlay, *S. cusia* (Nees) Brem., *S. dimorphotricha* Hance subsp. *rex* (C.B. Clarke) J.R.I. Wood, *S. karensium* Kurz, *S. maxwellii* J.R.I. Wood, *S. pateriformis* Lindau, and *S. brandisii* T. Anderson. Crude extracts of all plants exhibited antiplasmodial activity, however, CH_2Cl_2 crude extracts of *A. nemorum*, *S. corrugata*, *S. cusia*, *S. maxwellii*, *S. pateriformis*, and *S. brandisii*, together with MeOH extracts of *J. balansae* and *J. procumbens*, showed the most potent antiplasmodial activity with the IC_{50} values of 10-100 μg/mL. It should be noted that among the plants that showed good antiplasmodial activity (IC_{50} values of 10-100 μg/mL), their active agents were in a CH_2Cl_2 extract, except that of the genus Justicia (*J. balansae* and *J. procumbens*) which were in a MeOH extract. These results imply that most active antiplasmodial compounds in these plants are mostly non-polar. A number of studies revealed that bioactive compounds in *J. procumbens* were lignans and their glycoside derivatives, which possessed antiviral, antiplatelet, and anticancer activities (Chen *et. al*, 1996,1988; Asano *et. al*, 1996; Weng *et. al*, 2004; Tsao *et. al*, 2004; Day *et. al*, 2002; Fukamiya and Lee, 1986; Su *et. al*, 2006; Lee *et. al*, 2005; Lu *et. al*, 2008). An antifungal alkaloid, tryptanthrin, and lignan and phenylethanoid glycosides were isolated from *S. cusia* (Honda and Tabata, 1979; Tanaka *et. al*, 2004), while its leaf extract exhibited antinociceptive, anti-inflammatory and antipyretic effects (Ho *et. al*, 2003). To our knowledge, there have been no reports on antiplasmodial activity of crude extracts or pure compounds from *A. nemorum*, *J. balansae*, *J. procumbens*, *S. corrugata*, *S. cusia*, *S. maxwellii*, *S. pateriformis*, and *S. brandisii*.

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CH_2Cl_2 extracts of nine plants including *D. burmanni*, *H. ringens*, *J. balansae*, *J. procumbens*, *L. incurva*, *P. lanceolaria*, *P. dorsiflora*, *S. corrugata*, and *S. maxwellii* showed cytotoxic activity with the IC_{50} values of 3.5-46.0 μg/mL (Table 3). It should be noted that cytotoxic agents were mostly in the CH_2Cl_2 extracts and that these plant extracts were selectively active toward HepG2 and MOLT-3 cell lines. Cytotoxic compounds were previously isolated from *J. procumbens* (Tsao *et. al*, 2004; Day *et.al*, 2002; Fukamiya *et. al*, 1986; Su *et. al*, 2006; Lee *et.al*, 2005; Lu *et.al*, 2008), and some showed interesting mechanisms of action including inhibition of the transport of tumor necrosis factor-alpha to cell surface in lipopolysaccharide-stimulated RAW 264.7 macrophages(Tsao *et. al*, 2004); enhancement of tumor-necrosis factor-alpha (TNF-alpha) generation (Day *et. al*, 2002); induction of apoptosis (Su *et. al*, 2006; Lee *et. al*, 2005); and DNA-cleavage activity (Lu *et. al*, 2008).

CH_2Cl_2 extract of *J. procumbens* and MeOH extracts of *R. kerrii*, and *S. auriculata*, showed the ability to scavenge DPPH free radicals with percent inhibition at 56 %, 83 %, and 82 %, respectively (Table 3). However, most Acanthaceae extracts could not inhibit (at 40μg/mL) the TPA-induced superoxide anion radical formation in differentiated HL-60 cell line, except a marginal 51 % inhibition of *P. lanceolaria* extract. Some plant extracts including CH_2Cl_2 extracts of *J. procumbens* and *S. corrugata*, and a MeOH extract of *L. incurva* showed cytotoxicity towards HL-60 cell line at the tested concentration. In the X/XO assay, eight plant extracts including *A. nemorum*, *B. cristata*, *P. lanceolaria*, *R. kerrii*, *S. auriculata*, *S. corrugata*, *S. maxwellii*, and *S. brandisii* could scavenge superoxide anion radicals with 51-88 % inhibition. It should be noted that most active components were in MeOH extracts except for *A. nemorum* and *S. maxwellii*, implying that radical scavenging molecules were relatively polar. Antioxidant activity in the ORAC assay revealed that crude MeOH extracts of *B. cristata*, *J. procumbens*, *R. kerrii*, and *S. auriculata* exhibited antioxidant activity with the ORAC units of 3.1-3.9; the activity of these plants was observed only in the MeOH extracts, implying that the compounds responsible for this activity were relatively polar. From our experience, compounds showing antioxidant activity with ORAC assay always have phenolic hydroxyl groups which

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are necessary for the activity (Chomcheon *et.al*, 2009), and a separate study also indicates the importance of phenolic hydroxyl groups for antioxidant activity (Feng and Liu, 2009).Cancer prevention by chemopreventive agents is a challenging approach (Qian *et.al*, 2009), and antioxidant activity of natural products is considered as one of important cancer chemoprevention mechanisms (Gerhauser, 2008). To our knowledge, there have been no reports on antioxidant and radical scavenging properties of the plants investigated here.

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Table 3 Antiplasmodial, cytotoxic, antioxidant, and radical scavenging activities of CH_2Cl_2 and MeOH crude extracts of Acanthaceae

Taxa	Crude extract	Antiplasmodial activity (IC50, mg/mL)	Cytotoxic activity (IC_{50}, μg/mL)				Antioxidant and radical scavenging tivities (% Inhibition or ORAC unit)			
			HepG2	MOLT-3	HuCCA-1	A549	DPPH	HL-60	X/XO	ORAC
A. nemorum	CH_2Cl_2	10-100	I	I	I	I	I	I	58%	0.3
	MeOH	100-1000	I	I	I	I	I	I	I	1.2
B. cristata	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	1.3
	MeOH	100-1000	I	I	I	I	I	I	59%	3.2
B. strigosa	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	0.5
	MeOH	>1000	I	I	I	I	I	I	I	0.5
D. burmanni	CH_2Cl_2	100-1000	I	8.9±0.3	I	38.0±1.4	I	I	I	0.4
	MeOH	100-1000	I	I	I	I	I	I	I	0.9
E. tetragonum	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	0.1
	MeOH	100-1000	I	I	I	I	I	I	I	0.8
H. ringens	CH_2Cl_2	100-1000	I	16.5±0.5	I	I	I	I	I	0.5
	MeOH	100-1000	I	I	I	I	I	I	I	0.5
J. balansae	CH_2Cl_2	100-1000	6.0±0.0	3.5±0.2	43.0±3.5	21.0±5.6	I	I	I	1.3
	MeOH	10-100	32.3±4.0	33.7±2.8	I	I	I	I	I	0.7

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Table 3 (Continued)

Taxa	Crude extract	Antiplasmodial activity (IC50, mg/mL)	Cytotoxic activity (IC_{50}, μg/mL)				Antioxidant and radical scavenging tivities (% Inhibition or ORAC unit)			
			HepG2	MOLT-3	HuCCA-1	A549	DPPH	HL-60	X/XO	ORAC
J. procumbens	CH_2Cl_2	100-1000	18.3±6.5	38.5±2.7	46.0±0.7	31.0±0.0	56%	Toxic	I	3.9
	MeOH	10-100	I	I	I	I	I	I	I	3.1
L. incurva	CH_2Cl_2	100-1000	39.0±2.6	31.7±3.2	I	I	I	I	I	0.8
	MeOH	100-1000	32.5±3.5	42.3±8.1	I	I	I	Toxic	I	0.7
P. lanceolaria	CH_2Cl_2	100-1000	I	35.9±0.5	I	I	I	51%	I	0.6
	MeOH	100-1000	I	I	I	I	I	I	51%	1.2
P. dorsiflora	CH_2Cl_2	100-1000	44.3±4.1	35.1±1.8	I	I	I	I	I	1.1
	MeOH	100-1000	I	I	I	I	I	I	I	1.8
R. kerrii	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	0.5
	MeOH	100-1000	I	I	I	I	83%	I	79%	3.3
S. auriculata	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	0.7
	MeOH	100-1000	I	I	I	I	82%	I	88%	3.9
S. corrugate	CH_2Cl_2	10-100	I	15.2±1.1	I	I	I	Toxic	I	0.3
	MeOH	100-1000	I	I	I	I	I	I	57%	1.4

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Table 3 (Continued)

Taxa	Crude extract	Antiplasmodial activity (IC50, mg/mL)	Cytotoxic activity (IC_{50}, μg/mL)				Antioxidant and radical scavenging tivities (% Inhibition or ORAC unit)			
			HepG2	MOLT-3	HuCCA-1	A549	DPPH	HL-60	X/XO	ORAC
S. cusia	CH_2Cl_2	10-100	I	I	I	I	I	I	I	0.6
	MeOH	10-100	I	I	I	I	I	I	I	1.1
S. dimorphotricha	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	0.7
var. *rex*	MeOH	100-1000	I	I	I	I	I	I	I	1.3
S. karensium	CH_2Cl_2	100-1000	I	I	I	I	I	I	I	0.4
	MeOH	100-1000	I	I	I	I	I	I	I	1.3
S. maxwellii	CH_2Cl_2	10-100	I	8.9±0.3	I	I	I	I	59%	0.7
	MeOH	100-1000	I	I	I	I	I	I	I	0.6
S. pateriformis	CH_2Cl_2	10-100	I	I	I	I	I	I	I	0
	MeOH	100-1000	I	I	I	I	I	I	I	0.4
S. brandisii	CH_2Cl_2	10-100	I	I	I	I	I	I	I	0.1
	MeOH	100-1000	I	I	I	I	I	I	54%	0.8

Antiplasmodial activity: IC_{50} ranges were obtained by linear regression calculation using % inhibitions from four tested concentrations at 1000, 100, 10 and 1 μg/mL. Accordingly, approximate IC_{50} values are represented in ranges of 1-10; 10-100; and 100-1000 μg/mL.**Cytotoxic activity**: I = Inactive at 50 μg/mL; HepG2 = human hepatocellular liver carcinoma cell line; MOLT-3 = T-lymphoblast (acute lymphoblastic leukemia) cell line; HuCCA-1 = human lung cholangiocarcinoma cancer cells; and A549 = human lung carcinoma cell line.**Antioxidant and radical scavenging activities**: I = Inactive (%inhibition < 50); DPPH = Scavenging 2,2-diphenyl-1-picrylhydrazyl free radicals, crude extracts tested at 100 μg/mL; HL-60 = Inhibition of 12-*O*-tetradecanoylphorbol-13-acetate-induced superoxide anion radical generation in differentiated HL-60 cells, crude extracts tested at 40 μg/mL;X/XO = Inhibition of superoxide anion radical formation by xanthine/xanthine oxidase, crude extracts tested at 200 μg/mL; and ORAC (oxygen radical absorbance capacity-against ROO·), crude extracts tested at 2.5 μg/mL; One ORAC unit equals the net protection of β-phycoerythrin produced by 1 μM of Trolox.

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CONCLUSIONS AND RECOMMENDTATION

1. Taxonomic studies on the subtribe Ruelliinae, Acanthaceae in Thailand were conducted by specimens examined from BKF, BK, BM, CMU (science faculty), Kew and SLR and literatures searched. Additional field surveys and specimen collected of the family were made.

1. The representative of each genus in Ruelliinae, *Acanthaceae* In Thailand were selected to studied in 16 species, distributed in 8 genera (excepted *Diceratotheca*) i.e. *C. parviflora*, *D. erecta, E. macrophyllum, E. suffructicosum*, *H. ringens*, *P. dorsiflora, R. blechum, R. kerrii*, *R. tuberosa, Sanchezia oblonga, Strobilanthes abbreviata, S. auriculata* var. *auriculata*, *S. chinensis, S. corrugata, S. quadrifaria* and *S. schomburgkii*. Mostly of pollen grains are generally homogenous, excepted only *H. ringens* var. *ringens* is heterogenous. They are monads, heteropolar, 3-colpate, 3-colporate, 3-porate, prolate, subprolate, sub-speroidal, subprolate, prolate spheroidal, oblate spheroidal. The pollen size is medium to large (P= 31.53-84.62, E= 15.93-84.77). The exines sculpturing is reticulate, open-reticulate, bireticulate and scrabrate

2. The subtribe Ruelliinae, family Acanthaceae in Thailand founded 9 genera, Clarkesia J.R.I. Wood (1 species), Diceratotheca J.R.I. Wood (1 species), Dyschoriste Nees (1 species), Eranthemum L.(6 species), Hygrophila R. Br.(6 species), Phaulosis Willd.(1 species), Ruellia L.(8 species), Sanchizia Ruiz & Pav.(1 species), Strobilanthes Blume (49 species 52 taxa) and unplaced species (1 species) the total number of species are 75 species 78 taxa. The species in this studied are as followed: *Clarkeasia parviflora* (T. Anderson) J.R.I. Wood, *Diceratotheca bracteolata* J.R.I. Wood & Scotland, *Dyschoriste erecta* Kuntze, *Eranthemum ciliatum* (Craib) Benoist, *E. macrophyllum* Wall. ex Nees, *E. obovatum* J.B. Imlay, *E. strictum* Colebr. ex Roxb., *E. suffruticosum* Roxb, *E. tetragonum* A. Dietr**.** ex Nees, *Hygrophila biplicata* (Nees) Sreem., *H. corymbosa* (Blume) Lindau, *H. erecta* (Burm. f.) Hocchr., *H. phlomoides* Nees, *H. polysperma* (Roxb.) T. Anderson, *H. ringens* (L.) R. Br. ex Spreng. var. *ringens*, *Phaulopsis dorsiflora* (Retz.) Santapau,

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Ruellia bella Craib, *R. blechum* L., *R. kerrii* Craib, *R. macrosiphon* Kurz , *R. patula* Jacq., *R. repens* L., *R. tuberosa* L., *Sanchezia oblonga* Ruiz & Pav., *Strobilanthes abbreviata* Y.F. Deng & J.R.I. Wood, *S. alboviridis* J.B. Imlay, *S. alternata* (Burm. f.) P. Charoenchai (unpublished), *S. anamitica* Kuntze., *S. aprica* (Hance) T. Anderson, *S. argentea* J.B. Imlay, *S. articulata* J.B. Imlay, *S. auriculata* Nees. *S. bilabiata* J.R.I. Wood, *S. brandisii* T. Anderson, *S. chiangdaoensis* Terao, *S. chinensis* (Nees) J.R.I. Wood & Y.F. Deng, *S. confinis* (Nees) P.Charoenchai (unpublished), *S. consors* C.B. Clarke, *S. corrugata* J.B. Imlay, *S. cruciata* (Bremek.) Terao, *S. cusia* (Nees) Kuntze, *S. dalzielii* (W.W. Sm.) Benoist, *S. decumbens* (Bremek.) J.R.I. Wood, *S. denticulata* (Nees) T. Anderson, *S. dimorphotricha* Hance. subsp. *rex*, *S. echinata* Nees, *S. erecta* C.B. Clarke, *S. fragrans* J.R.I. Wood, *S. glaucescens* Nees, *S. hamiltoniana* (Steudel) Bosser & Heine, *S. helferi* T. Anderson, *S. heliophila* J.R.I. Wood, *S. hispidula* (Craib) P. Charoenchai (unpublished), ,*S. hossei* C.B. Clarke, *S. imbricata* Nees, *S. karensium* Kurz, *S. lanceifolia* T. Anderson., *S. maxwellii* J.R.I. Wood, *S. moschifera* Blume, *S. palawanensis* Elmer, *S. paniculata* T.Anderson, *S. pateriformis* Lindau, *S. Pedunculosa* Miq., *S. peninsularis* Terao, *S. polystachya* Benoist, *S. quadrifaria* (Wall. ex Nees) Y.F. Deng, *S. reptans* (G. Forst.) Moylan ex Y.F. Deng & J.R.I. Wood, *S. rivularis* J.R.I. Wood & J.R. Benn., *S. repanda* (Blume) J.R. Bennett., *S. rufescens* (Roth) T. Anderson, *S. schomburgkii* (Craib) J.R.I. Wood, *S. serrata* J.B. Imlay, *S. speciosa* Blume, *S. tenuiflora* J.R.I. Wood and *S. tonkinensis* Lindau. Three species are new name after transferred from genus *Hemigraphis* (Mallbery, 1987) i.e. *S. alternata* (Burm. f.) P. Charoenchai, *S. confinis* (Nees) P.Charoenchai and *S. hispidula* (Craib) P. Charoenchai. And and 1 species unplaced in Strobilanthes genus is *Hemigraphis repanda* (L.) Hallier f. because of specific epithet name cannot be the same name by rules of ICBN.

4. Some plant extracts in the family Acanthaceae showed antiplasmodial, cytotoxic, antioxidant and radical scavenging activities. A number of plants screened here have never been chemically explored. Therefore, based upon these screening data, the investigation of bioactive compounds from the Acanthaceae plants is interesting to be pursued.

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APPENDIX

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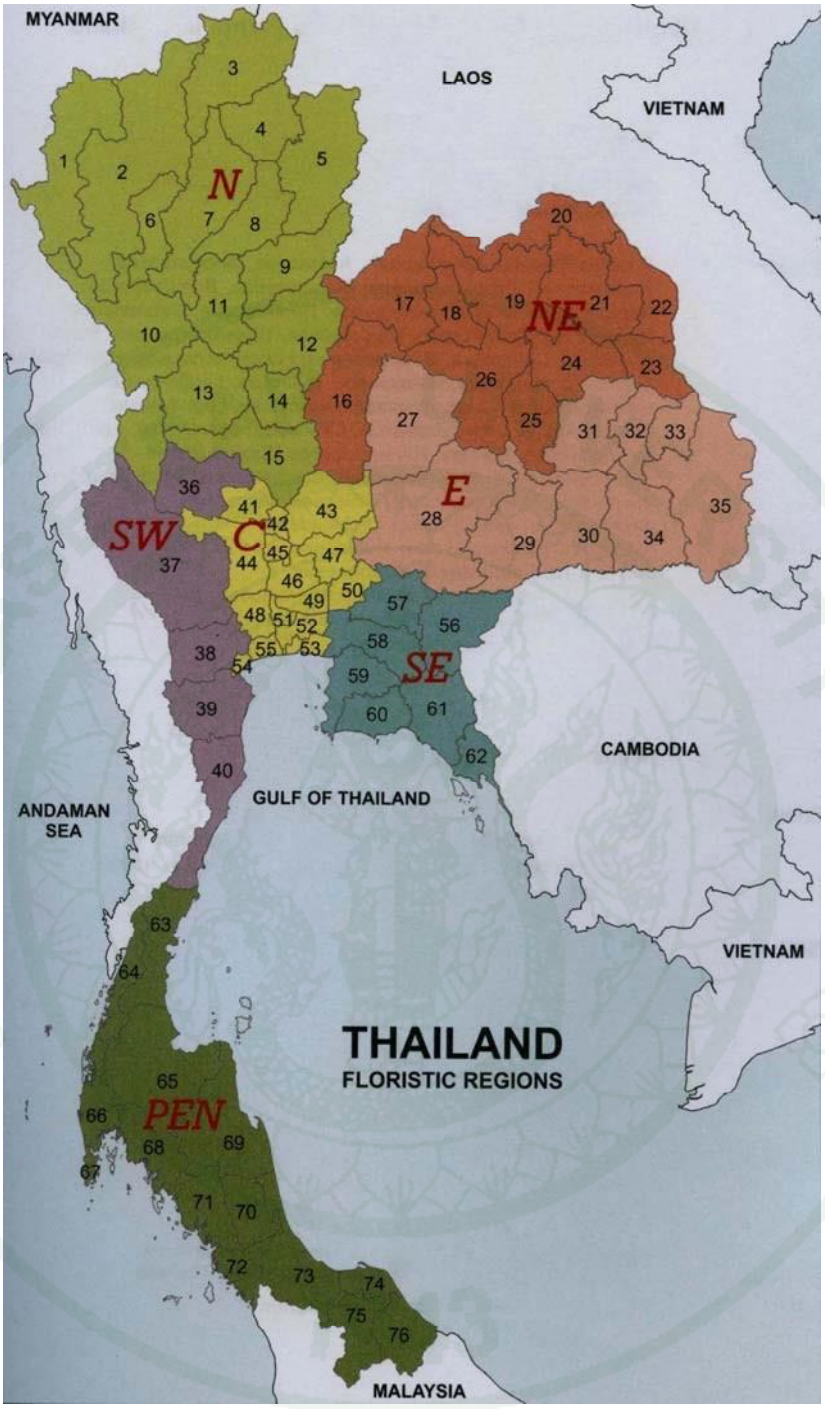

Appendix Figure 1 Floristic regions and provinces of Thailand. N= northern; NE= northeastern; E= eastern; SW= southwestern; C= central; SE= southeastern; Pen= peninsular.

Source: The Forest Herbarium, Royal Forest Department (2001).

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FLORISTIC REGIONS AND PROVINCES OF THAILAND

N (NORTHERN)

1 Mae Hong Son
2 Chiang Mai
3 Chiang Rai
4 Phayao
5 Nan
6 Lamphun
7 Lampang
8 Phrae
9 Uttaradit
10 Tak
11 Sukhothai
12 Phitsanulok
13 Kamphaeng Phet
14 Phichit
15 Nakhon Sawan

NE (NORTHEASTERN)

16 Phetchabun
17 Loei
18 Nong Bua Lum Phu
19 Udon Thani
20 Nong Khai
21 Sakon Nakhon
22 Nakhon Phanom
23 Mukdahan
24 Kalasin
25 Maha Sarakham
26 Khon Kaen

E (EASTERN)

27 Chaiyaphum
28 Nakhon Ratchasima
29 Buri Ram
30 Surin
31 Roi Et
32 Yasothon
33 Amnat Charoen
34 Si Sa Ket
35 Ubon Ratchathani

SW (SOUTHWESTERN)

36 Uthai Thani
37 Kanchanaburi
38 Ratchaburi
39 Phetchaburi
40 Prachuap Khiri Khan

C (CENTRAL)

41 Chai Nat
42 Sing Buri
43 Lop Buri

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FLORISTIC REGIONS AND PROVINCES OF THAILAND (CONTINUED)

44 Suphan Buri
45 Ang Thong
46 Phra Nakhon Si Ayutthaya
47 Saraburi
48 Nakhon Pathom
49 Pathum Thani
50 Nakhon Nayok
51 Nonthaburi
52 Krung Thep Maha Nakhon (Bangkok)
53 Samut Prakan
54 Samut Songkhram
55 Samut Sakhon

SE (SOUTHEASTERN)

56 Sa Kaeo
57 Prachin Buri
58 Chachoengsao
59 Chon Buri
60 Rayong
61 Chanthaburi
62 Trat

PEN (PENINSULAR)

63 Chumphon
64 Ranong
65 Surat Thani
66 Phangnga
67 Phuket
68 Krabi
69 Nakhon Si Thammarat
70 Phatthalung
71 Trang
72 Satun
73 Songkhla
74 Pattani
75 Yala
76 Narathiwat

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CODE GENERA AND SPECIES NUMBERS

1. **Clarkesia** J.R.I. Wood
   1.1 *C. parviflora* (T. Anderson) J.R.I. Wood

2. **Diceratotheca** J. R. I. Wood
   2.1 *D. bracteolata* J.R.I. Wood & Scotland

3. **Dyschoriste** Nees
   3.1 *D. erecta* (Burm. f.) Kuntze

4. **Eranthemum** L.
   4.1 *E. ciliatum* (Craib) Benoist
   4.2 *E. macrophyllum* Wall. ex Nees
   4.3 *E. obovatum* J.B. Imlay
   4.4 *E. strictum* Colebr. ex Roxb.
   4.5 *E. suffruticosum* Roxb.
   4.6 *E. tetragonum* A. Dietr. ex Nees

5. **Hygrophila** R. Br.
   5.1 *H. biplicata* (Nees) Sreem.
   5.2 *H. corymbosa* (Blume) Lindau
   5.3 *H. erecta* (Burm. f.) Hocchr.
   5.4 *H. phlomoides* Nees
   5.5 *H. polysperma* (Roxb.) T. Anderson
   5.6 *H. ringens* (L.) R. Br. ex Spreng. var. *ringens*

6. **Phaulosis** Willd.
   6.1 *P. dorsiflora* (Retz.) Santapau

7. **Ruellia** L.
   7.1 *R. bella* Craib
   7.2 *R. blechum* L.
   7.3 *R. kerrii* Craib
   7.4 *R. macrosiphon* Kurz
   7.5 *R. patula* Jacq.
   7.6 *R. repens* L.
   7.7 *R. simplex* C.Wright
   7.8 *R. tuberosa* L.

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8. **Sanchizia** Ruiz & Pav.

    8.1 S. oblonga Ruiz & Pav.

9. **Strobilanthes** Blume

    9.1 *S. abbreviata* Y.F. Deng & J.R.I. Wood

    9.2 *S. alboviridis* J.B. Imlay

    9.3 *S. alternata* (Burm. f.) P. Charoenchai (unpublished)

    9.4 *S. anamitica* Kuntze

    9.5 *S. aprica* (Hance) T. Anderson

    9.6 *S. argentea* J.B. Imlay

    9.7 *S. auriculata* Nees

        9.7a var. *auriculata*

        9.7b var. *dyriana*

    9.8 *S. bilabiata* J.R.I. Wood

    9.9 *S. brandisii* T. Anderson

    9.10 *S. chiangdaoensis* Terao

    9.11 *S. chinensis* (Nees) J.R.I. Wood & Y.F. Deng

    9.12 *S. confinis* (T. Anderson) P. Charoenchai (unpublished)

    9.13 *S. consors* C.B. Clarke

    9.14 *S. corrugata* J.B. Imlay

    9.15 *S. cruciata* (Bremek.) Terao

    9.16 *S. cusia* (Nees) Kuntze

    9.17 *S. dalzielii* (W.W. Sm.) Benoist var. *inaqualis*

    9.18 *S. decumbens* (Bremek.) J.R.I. Wood *S. denticulata* (Nees) T. Anderson

    9.20 *S. dimorphotricha* Hance.

        9.20a subsp. *dimorphotricha*

        9.20b subsp. *rex*

    9.21 *S. echinata* Nees

    9.22 *S. erecta* C.B. Clarke

    9.23 *S. fragrans* J.R.I. Wood

    9.24 *S. glaucescens* Nees

    9.25 *S. hamiltoniana* (Steudel) Bosser & Heine

    9.26 *S. helferi* T. Anderson

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9.27 *S. heliophila* J.R.I. Wood

9.28 *S. hispidula* (Craib) P. Charoenchai (unpublished)

9.29 *S. hossei* C.B. Clarke

9.30 *S. imbricata* Nees

9.31 *S. karensium* Kurz

9.32 *S. lanceifolia* T. Anderson

9.33 *S. maxwellii* J.R.I. Wood

9.34 *S. microcarpa* T. Anderson

9.35 *S. moschifera* Blume

9.36 *S. palawanensis* Elmer

9.37 *S. paniculata* T. Anderson

9.38 *S. pateriformis* Lindau

9.39 *S. pedunculosa* Miq.

9.40 *S. quadrifaria* (Wall. ex Nees) Y.F. Deng

9.41 *S. repanda* (Blume) J.R. Bennett.

9.42 *S. reptans* (G. Forst.) Moylan ex Y.F. Deng & J.R.I. Wood

9.43 *S. rivularis* J.R.I. Wood & J.R. Benn.

9.44 *S. rufescens* (Roth) T. Anderson

9.44a subsp. *parvibracteata*

9.44b subsp. *parishii*

9.44 *S. schomburgkii* (Craib) J.R.I. Wood

9.45 *S. serrata* J.B. Imlay

9.46 S. speciosa Blume

9.47 *S. tenuiflora* J.R.I. Wood

9.48 *S. tonkinensis* Lindau

9.50 *Hemigraphis repanda* (L.) Hallier f. (unplaced species)

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INDEX TO COLLECTOR'S NUMBER

(number after collector's representing the code genera and species numbers)

Adisai 174: 9.24 (BK); **311:** 4.6 (BK); **326**: 3.1 (BK); **376**: 5.2 (BK); **685**: 9.20b (BK).

Amnat 58: 7.4 (BKF).

Anonymous 1: 7.7 (K); **145**: 9.45 (Type H. schomburgkii-K); **2313**: 3.1 (BK); **286**: 3.1 (BKF); **515** : 9.24(BKF); **675**: 9.47 (BK); **776**: 9.45 (PSU-2 dup.); **782**: 9.24 (BKF).

Beusecom, Phengklai, Geesink & Wongwan 3725: 9.30 (BKF); **3781**: 9.7a (BKF, K-2 dup.); **9097**: 9.20b (BKF, K).

Beusekom & Phengkhlai 44: 9.49 (K); **120**: 7.6 (BKF, K); **514:** 7.6 (BKF, K, SLR); **515**: 7.4 (K); **2320**: 9.40 (BKF).

Bloembergen 602: 9.9 (BK, K) (In Type BK).

Boonkird 101: 9.32 (BKF).

Boyce 998: 9.29 (K);

Brockelman,W. 29: 9.21 (BKF);

Bunchuai 62: 7.6 (BKF); **103**: 9.20b (BKF); **716**: 9.20b (BKF); **789**: 9.10 (BKF); **1346**: 9.40 (BKF); **1349**: 9.5 (BK, BKF, K); **1416**: 9.7a (BKF);

Bunpheng 77: 7.7 (BKF); **955**: 9.22 (BKF, K)

Carpenter 5: 9.1 (K);

Chaloemphol 401: 9.24 (BKF, K, SLR); **414**: 9.30 (BKF, SLR).

Chamchumroon, Puff & Koonkhunthud 1277: 9.32(BKF-2 dup.).

Chamchumroon, Puff, Suphuntee, Ngernsaensaruay & Testsana 1678: 9.20b (BKF- 2 dup.); **1680**: 9.14 (BKF-3 dup.); **1744** : 9.22(BKF); **1766**: 9.30(BKF); **1774**: 9.40 (BKF).

Chantaranothai & Parnell 90/497: 3.1 (K); **90/684**: 3.1 (K).

Charoenphol 407: 9.7a (BKF).

Charoenphol, Lasen &Warncke 4803: 9.20b (BKF); **4865**: 9.30 (BKF); **4874**: 9.30 (BKF); **4885**: 3.1 (BKF, K).

Chayamarit 40: 9.45 (BKF- 2 dup.); **1042**: 9.40 (BKF).

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Chayamarit & Phatanacharoen 656 : 9.13 (BKF); **680**: 9.20b (BKF).

Chayamirit et al. 3113: 6.1 (BKF); **3119**: 9.20b (BKF); **3146**: 9.20b (BKF); **3156**: 9.40 (BKF); **3238**: 9.20b (BKF).

Cheke, T. 18: 9.40 (BKF).

Chenghittikul 833: 9.3 (SLR).

Chermsirivathana 204: 5.4 (BK); **251**: 5.4 (BK); **305**: 9.1 (BK, BKF, SLR); **324** : 4.6(BK); **641**: 4.6 (BK); **673**: 9.13 (BK); **674**: 9.32 (BK); **872**: 9.22 (BK); **1084**: 9.22 (BK); **1101**: 9.1 (BK); **1161**: 9.9 (BK); 1572A: 9.13 (BK); **1585**: 1.1 (BK).

Collins 1218: 4.6 (BK); **1814**: 5.4 (BK); **1815**: 5.4 (BK, K); **1832**: 9.11 (BK)]; **1690**: 5.6 (BK, K);

CP 3176: 9.7a (BKF).

Damrongsak 433: 3.1 (BKF)

Dee 12: 9.40 (BKF); **17**: 3.1(BKF); **Dee** 47: 9.40 (BKF); **368**: 9.30 (BKF); **374**: 9.40 (BKF); **383**: 9.7a (BKF).

Dee Bunpheng 11: 9.5 (BKF, K); **335**: 3.1(BKF, K); **632**: 9.20b (K);

633: 9.20b (BKF).

Devakul 2: 9.16 (BK).

Din Nakkarn 37: 9.30 (BKF).

Eryl Smith 173: 5.6 (BK), **396**: 9.29 (BK, BM); **538**: 9.47 (BK, BM).

Forestry Students s.n. (BKF); Forestry Students s.n.: 9.20b (BKF).

Fukuoka T. 4447: 9.7a (BKF); **Fukuoka T. 7076**: 7.7 (BKF).

Fukuoka & Ito T. 35428: 9.7a (BKF); **T. 34609**: 9.9 (BKF).

Fukuoka & Koyama T. 62115: 9.20b (BKF); **T. 62122**: 9.20b (BKF).

Garrett 75: 9.20b (BKF, BM, K); **102** : 9.7a (BM); **195**: 7.3 (BKF, K); **217**: 9.40 (BKF, K); **488**: 9.48 (K); **564**: 9.21 (BKF, K); **841**: 9.20b (BKF, K); **1015**: 9.7a (BKF, K); **1026** : 9.13(BKF, K); **1034** : 9.20b (BKF, K-2 dup.); **1108**: 9.22 (K); **1225**: 9.1 (K); **1281**: 4.6(K); **1399**: 9.30 (K); **1402** : 9.30 (Type P. garrettii-K); **1426**: 9.16 (BKF, K).

Geesingk, Hattink & Phengklai 7129: 9.21 (BKF, K).

Geesink & Maxwell 8377: 9.11 (BKF).

Geesink & Santisuk 4865: 9.32(BKF); **5153**: 9.32 (BKF).

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Geesink, Hiepko & Phengklai7626: 9.27 (BKF, K); **8018**: 9.10 (BKF); **8058**: 9.20b (BKF); **8117**: 9.20b (BKF, K); **8219**: 9.40 (BKF).

Gen Murata T. 42518: 9.20a (BK).

Goring 19 : 9.29 (K).

Groff 6076: 7.7 (K).

Haniff 378 : 9.32 (K);

Haniff & Nur 3572: 4.5 (K); **3628**: 9.40 (K); **3958**: 9.3 (K).

Hansen & Smitinand 11806: 6.1(BKF, K-2 dup.); **11977**: 5.6 (BKF, K); **12044** : 9.21(BKF); **12604**: 9.20b (BKF); **12668**: 9.13 (BKF, K); **12698**: 6.1: 6.1(K); **12798**: 9.20b (BKF); **12743**: 9.47 (BKF, K);

Hansen, Seidenfaden & Smitinand 10872: 9.47 (BKF, SLR); **10904**: 9.20b (BKF); **10961**: 5.2 (BKF); **11039**: 9.40 (BKF).

Hennipman 3187: 9.10 (BKF, Isotype-K); **3273**: 9.22 (BKF); **3494**: 9.5 (BKF, K); **3572**: 9.22 (BKF); **3610**: 9.38 (BKF, K).

Hiroshige & Terao T. 30546 : 9.24(BKF).

Hosseus 248: 9.20b (BM, K); **251**: 9.7a (BM); **256** : 9.13(BM, Type-K); **265**: 9.40 (K); **297**: 9.7a (K); **336**: 9.20b (BM, K); **339** : 9.29 (BM, Type-K); **352**: 9.20b: 9.20b (Type S.rex-K, BM); **402A**: 9.31 (BM, Type S.lilacina-K); **717a**: 9.40 (K).

Indrapong 39: 9.37(BKF).

Iwatsuki T. 253: 7.7 (BKF).

Iwatsuki & Fukuoka T. 3228: 9.31 (BKF); T. **3497**: 9.20b (BKF); **T. 3970**: 9.40 (BKF); **T. 7096**: 9.35 (BKF).

Iwatsuki, Fukuoka & Chintayungkun T.9572: 9.21(BKF, K).

Iwatsuki, Koyama, Fukuoka & Nalampoon T. 9421: 9.30 (BKF).

Iwatsuki, Koyama, Hutoh & Chintayungkun T. 8329: 9.21 (BKF).

Iwatsuki, Phengklai & Santisuk T. 27784: 7.7 (BKF).

Jaray 77: 9.9 (BK).

Jaray, Parikarn & Prayad 212: 9.41 (BK).

K. B. 3046: 9.24(BKF); **1049** : 7.6 (BKF).

Kasin 352: 9.42 (BK), **346**: 5.3 (BK).

Kerr, A.F.G. s.n.: 7.6 (BM); **s.n**.: 7.7 (BM); **s.n.**: 9.16 (BM); **s.n**.: 9.20b (BM); **s.n**.: 9.30 (BK, BM); **s.n.**: 5.2 (BK); **s.n.**: 7.1 (BM); **s.n.**: 7.6 (BM); **s.n.**: 9.20b (BM); **s.n.**:

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9.20b (BM); **s.n.**: 9.47 (BM); **s.n.**: 9.7a (K); **s.n.** : 9.13(BM); **s.n.** : 9.13(BM); **s.n.** : 9.13(BM); **s.n**.: 7.4 (BM); **s.n**.: 9.13 (BM) **884**: 9.30 (BM, K); **927**: 9.7a (BM, K); **935** : 9.20b (BM, K); **948**: 4.6 (K); **988** : 9.47 (BM, type S. ii-K); **995** : 9.41 (BM, isotype *S. rubro-glandulosus*-K); **1430**: 9.5 (BM, K); **1542**: 9.40 (K); **1542B**: 9.40 (K); **1568**: 9.20b (BM); **1568A**: 9.20b (K); **1568B**: 9.20b (BM, K); **1611B**: 6.1 (K); **1628B**: 5.6 (K); **1854**: 7.4 (BM, K); **2151**: 7.7 (BM, K); **2175**: 7.3 (BM, Type R. ii-K); **2208**: 3.1 (K); **2266:** 3.1 (K); **2279, 2279A**: 9.13 (BM, K); **2296**: 9.7a (BM, Type *S.venustus*-K); **2324**: 3.1 (K); **2383**: 9.28 (K); **2383A** : 9.28 (K); **2397**: 9.16 (BK, BM, K); **2398**: 4.1 (K); **2442** : 9.49 (BM, isotype *S.niveus*-K); **2451** : 9.16 (BM, K); **2604**: 9.9 (BM); **2715**: 9.13 (BM, K); **2715**: 9.13 (BM, K); **2874**: 9.14 (BM, holotype *S.viscida*-K); **3078**: 9.7a (BM, K); **3127** : 9.41 (BM, K); **3537**: 9.20b (BM, K); **3604**: 7.5 (K); **3605**: 7.1 (BM, type-K); **3753**: 7.6 (K); **3861**: 5.3 (BK); **3890**: 5.3: 5.3 (K); **3901**: 5.3 (K); **3913**: 5.6 (BM, K); **3951**: 5.2 (BK, BM, K); **4005**: 7.6 (K); **4095**: 5.6 (K); **4296**: 9.3 (K); **4532**: 6.1 (K); **4582**: 7.5 (BK, BM, K); **4660**: 3.1 (BK, K); **4743** : 9.13 (BK, BM, K); **4903**: 9.41 (BK, BM, K); **4944**: 1.1 (type: *E. siamensis*-BK); **4993** : 9.21(BK, BM, K); **4998**: 9.17 (BK, BM,K); **5090**: 9.12 (K); **5465**: 7.6 (BK, K); **5308**: 9.21(BK, BM, K); **5696**: 7.5 (BK, BM, K); **6056**: 7.6 (BK, BM); **6118**: 9.5 (Type *S.gramineus*-BKF); **6405**: 5.6 (BK, K); **6584**: 9.46 (K); **6587**: 9.46 (Type-BK, BM, Holotype-K); **6609** : 9.31 (BK, BM); **6722**: 7.6 (BK, K); **6726**: 5.3 (BK, K); **6826**: 9.44b (BK, BM, K); **7305**: 7.6 (BK, BM); **7372** : 5.6 (BK, K); **7493**: 9.38 (BK, BM, K); **7641**: 5.4 (BK, K); **7893**: 7.6 (K); **7991**: 5.2 (BK, K); **8072**: 5.4 (BK, K) **8072**: 5.4 (BK, K); **8194**: 5.2 (BK, K); **8249**: 4.4 (BK, K); **8511** : 9.11(BK, K); **8760**: 7.1 (BK, K); **9092**: 7.6 (Type R. hirtella-BK, BM, K); **9305**: 9.44b (BK, BM, K); **9391**: 5.4 (BK, K); **9420**: 9.35 (BK, K); **9607**: 9.1 (BK, BM, K); **9629** : 9.9 (BK, BM, K); **9630**: 9.20a (type-BK); **9635**: 9.38 (BK, BM, K); **9693** : 9.11 (BK, K); **9693A**: 9.11 (BK); **9797**: 5.1 (BK); **9908** : 9.1(BK, BM, K); **9990**: 9.49 (BK, BM, K); **9993**: 9.41 (BK, BM, K); **10077**: 9.38 (BK, BM, K); **10267**: 9.2 (BK, BM, K); **10281**: 9.34 (BK, BM, K); **10286**: 9.1 (type *S. turgitinosus*-BK); **10309**: 9.34 (BK, BM, K); **10346** : 9.48(BK, BM, K); **10381** : 9.29 (BK, BM, K); **10451** : 9.48 (BK, BM, K); **10460** : 9.7a (BK, BM, K); **10462**: 5.2 (BK, K); **10601**: 5.2 (BK, K); **10835** : 9.21(type-BK, BM, type *S. maingayi* var. *glaber*-K); **11363** : 9.9 (BK, BM); **11493**: 9.2 (BK, BM, type-K); **11643**: 7.6 (BK, K); **11665** : 9.32 (BK, BM, K); **11669**: 9.1(BK); **11939**:

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9.37 (BK, K); **12074**: 9.9 (BK, BM, paratype-K); **12083**: 9.1 (BK); **12172**: 9.37(BM); **12172**: 9.37 (BK, K); **13308**: 7.6 (BK, BM, type *R. dissimilis*-K); **13632**: 5.4 (BK, K); **13790**: 5.4 (BK, K); **14502**: 9.32 (BK, K); **14509**: 9.29 (BK, BM, K); **14512**: 9.21 (BK, type *S. pectinatus* var. *acuminatus*-BM); **14528**: 9.21(BK, BM, K); **14611**: 4.5 (BK , K); **14954** : 9.21(BK, BM, K); **15229**: 9.32 (BK, BM, K); **15286**: 9.2 (BK, BM, K); **15420**: 9.47 (BM, K); **15464** : 9.21(BK, K); **15661**:9.12 (K); **15728**: 9.16 (BK, BM); **16229**: 5.6 (BK, K); **16236**: 9.37(BK, BM, K); **16262**: 9.32 (BK, K); **16273** : 9.37(BK); **16273**: 9.36 (BK, BM); **16335**: 9.9 (BK, BM, holotype *S. evrardii* var.*pauciflora*-K); **16513**: 9.32 (BK, BM, K); **16707**: 9.37(BK); **17179**: 9.32 (BK, BM, K); **17240**: 5.4 (BK, K); **17614**: 9.44b (BK, BM, K); **17678**: 9.2 (BK, K); **17768**: 9.7a (BK, BM); **17792** : 9.9 (BK, BM, K); **18050**: 5.4 (BK, K); **18097**: 9.45 (BK); **18474**: 9.32(BK); **18675**: 9.2 (BK, BM, K); **19190**: 9.21 (type-BK, type *S. latibracteatus*-BM); **19267**: 9.20b (BK); **19475**: 7.6 (BK, K); **19482**: 7.1 (K); **19760**: 7.3 (BK, BM, paratype *R. subulata*-K); **19760**: 7.3 (BK, K); **19760**: 7.6 (BK, BM, K); **19890**: 5.2 (BK, K); **19990**: 5.2 (BK, BM, K); **20017**: 4.1 (BK, K); **20603**: 3.1 (BK, K).

Kloss s.n.: 3.1 (K); **6049, 6859, 6860**: 9.32 (K), **7036**: 9.37 (K).

Konta & Khao-iem 11302: 9.22 (BKF-2 dup.).

Konta & Phengklai 4055: 9.46 (BKF); **4057**: 9.20b (BKF); **4672**: 9.20b (BKF-2 dup.).

Konta, Phengklai & Khao-iem 4087: 9.45 (BKF); **4694, 4689**: 9.22-(2 dup.) (BKF), **4694**: 9.22 (BKF); **4732**: 9.20b (BKF); **4780**: 9.20b (BKF); **4939**: 9.20b (BKF- 2 dup.); **4797**: 9.7a (BKF); **4816**: 9.7a (BKF); **5006**: 9.20b (BKF).

Kostermans 377: 9.26 (BK, K); **378**: 9.41 (BK, K).

Koyama & Nagamasu T.40123: 9.6 (BKF); **T. 40157** : 9.20b (BKF); **T. 39134**: 9.7a (BKF); **T. 39172**: 9.7a (BKF); **T. 39589**: 9.7a (BKF); **T. 39894**: 9.7a (BKF).

Koyama & Terao T. 30545: 7.7 (BKF); **T. 32846**: 7.7 (BKF).

Koyama &Nantasan T. 40076: 9.48 (BKF).

Koyama T.62055: 9.7a (BKF).

Koyama Terao & Wongprasert T. 31198: 9.24(BKF); **T.31983**: 9.46 (BKF, K); **T.33344**: 9.47 (BKF, K); **T. 33890**: 9.32 (BKF); **T.32040**: 9.29 (BKF, K, SLR).

Koyama, Konta & Nanakhorn T. 49025: 9.40 (BKF).

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Koyama, Mitsuta, Yahara, Nagamasu, Nanakhorn & Nantasan T. 39727: 9.30 (BKF).

Koyama, Phengklai, Mitsuta, Yahara, Nagamasu & Nantasan T. 39943 : 9.48 (BKF).

Koyama, Phengklai, Niyomdham, Tamura, Okada & O'Connor 15589: 5.2 (BKF-2 dup.).

Koyama, Phengklai, O'Connor & Niyomdham 15207: 9.32 (BKF-2 dup.)

Koyama, Terao & Wongprasert T. 31198: 9.24(BKF); **T. 31979**: 9.46 (BKF); **T.31983**: 9.46 (BKF, K); **T.32352**: 9.5 (BKF-2 dup., K, SLR); **T.32887**: 9.5 (BKF), **T.33344**: 9.47 (BKF, K); **T. 49025**: 9.40 (BKF).

Koyama, Mitsuta, Yahara, Nagamasu, Nanakhorn & Nantasan T. 39727: 9.30 (BKF).

Koyama, Phengklai, Mitsuta, Yahara, Nagamasu & Nantasan T. 39943: 9.48 (BKF).

Koyama, Phengklai, Niyomdham, Tamura, Okada & O'Connor 15589: 5.2 (BKF-2 dup.).

Koyama, Phengklai, O'Connor & Niyomdham 15207: 9.32 (BKF-2 dup.).

Koyama, Terao & Wongprasert T. 22192: 9.20b (BKF); **T.32352**: 9.5 (BKF-2 dup., K, SLR); **T. 30334**: 3.1 (BKF); **T. 30343**: 7.5 (BKF); **T. 30348**: 9.3 (BKF); **T. 30473**: 9.5 (BKF); **T. 30481**: 9.9 (BKF); **T. 30513**: 9.40 (BKF); **T. 30715**: 3.1(BKF); **T. 30751**: 7.6 (BKF); **T. 30849**: 4.4 (K); **T. 30859**: 3.1 (BKF); **T. 30862**: 5.2 (BKF); **T. 30877**: 5.2 (BKF); **T. 30894**: 5.2 (BKF); **T. 30918**: 7.6 (BKF); **T. 30947**: 3.1 (BKF); **T. 30945**: 9.7a (BKF, SLR); **T. 3103**3: 3.1 (BKF); **T. 31075**: 9.45 (BKF); **T. 31192**: 7.6 (BKF); **T. 31194**: 3.1 (BKF); **T. 31201**: 9.30 (BKF); **T.31227**: 9.9 (BKF); **T. 31306**: 9.20b (BKF); **T. 31318**: 9.20b (BKF); **T. 31522**: 9.20b (BKF); **T.31524**: 9.13 (BKF); **T. 31534** : 9.20b (BKF); **T. 31541**: 9.13 (BKF); **T. 31542, T. 31543**: 9.13 (BKF); **T. 31586** : 9.31 (BKF); **T. 31591** : 9.46 (BKF); **T. 31599**: 9.22 (BKF-2 dup.); **T. 31603**: 9.20b (BKF); **T. 31612** : 9.20b (BKF); **T. 31617**: 9.13 (BKF); **T. 31721**: 3.1 (BKF); **T. 31722**: 9.7a (BKF); **T. 31730**: 9.5 (BKF); **T. 31808**: 9.30 (BKF); **T. 31868**: 9.7a (BKF); **T. 31874**: 6.1 (BKF, K); **T.31980**: 9.29 (BKF, K); **T. 32030**: 9.29 (BKF, K); **T. 32031**: 9.20b (BKF, K); **T. 32041**: 9.20b (BKF); **T. 32098**: 9.43 (isotype: BKF-2dup., K); **T. 32104**: 9.7a (BKF); **T. 32122** : 9.7a (BKF-2 dup.); **T.**

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32177: 9.45 (BKF); **T. 32190**: 9.48 (BKF, K); **T. 32193**: 9.20b (BKF); **T. 32223**: 5.2 (BKF); **T. 32242**: 9.20b (BKF); **T. 32295**: 9.7a (BKF); **T. 32354**: 9.20b (BKF); **T. 32360**: 9.7a (BKF); **T. 32373**: 5.2 (BKF); **T. 32407**: 5.1 (BKF); **T. 32429**: 9.7a (BKF); **T. 32434**: 9.47 (BKF); **T. 32474**: 9.24 (BKF, K); **T. 32477**: 9.20b (BKF); **T.32486**: 9.40 (BKF); **T. 32487**: 9.24 (BKF); **T. 32501**: 6.1 (BKF); **T. 32506**: 9.30 (BKF); **T. 32588**: 9.20b (BKF); **T. 32647**: 9.47 (BKF, K); **T. 32650**: 9.40 (BKF); **T. 32652**: 9.44a (BKF); **T. 32666**: 9.24 (BKF); **T. 32697**: 9.20b (BKF- 2 dup.); **T. 32754**: 9.30 (BKF, K); **T. 32778**: 9.20b (BKF); **T. 33800**: 9.32(BKF, K); **T. 32828**: 9.9 (BKF, K); **T. 32823**: 9.47 (BKF); **T. 32894**: 5.2 (BKF); **T. 32929**: 6.1 (BKF); **T. 33072**: 9.45 (BKF); **T. 33151**: 9.20b (BKF); **T. 33203**: 9.20b (BKF); **T. 33212**: 9.20b (BKF); **T. 33214**: 9.31 (BKF); **T. 33224**: 9.47 (BKF); **T. 33225**: 9.10 (BKF); **T. 33248**: 9.24 (BKF, K); **T. 33251**: 9.40 (BKF); **T. 33252**: 9.44a (BKF, K); **T. 33254**: 6.1 (BKF); **T. 33311**: 6.1(BKF); **T. 33344**: 9.46 (BKF-2 dup.); **T. 33358**: 9.20b (BKF, K); **T. 33423**: 9.20b (BKF); **T. 33500**: 4.6 (K); **T. 33504**: 6.1 (BKF); **T. 33555**: 9.7a (BKF); **T. 33556**: 4.6 (K); **T. 33563**: 9.45 (BKF, K); **T. 33564**: 6.1 (BKF); **T. 33594**: 9.20b (BKF, K); **T. 33631**: 9.45 (BKF); **T. 33654**: 9.22 (BKF); **T. 33659**: 9.46 (BKF, K); **T. 33663**: 9.31 (BKF); **T. 33664**: 9.20b (BKF); **T. 33679**: 9.13 (BKF); **T. 33686**: 9.13 (BKF); **T. 33729**: 9.32 (BKF-2dup., K); **T. 33815**: 9.37 (BKF, K); **T. 33863**: 9.26 (BKF); **T. 33969**: 6.1 (BKF); **T. 34062**: 7.6 (BKF).

Kudjabnak & Watanachaiyingcharoen 0034: 9.20b (BKF).

Lakshnakara 262: 3.1 (BK, K); **338**: 9.29 (BK); **436**: 5.2 (BK); **501**:4.5 (BK, K); **1485**: 9.20b (BK); **1530**: 9.16 (BK).

Larsen & Larsen 34076: 7.3 (BKF);

Larsen 10159: 9.21(K); **10579**: 7.6 (BKF); **8096**: 7.3 (K); **8203**: 3.1 (K); **8436**: 7.6 (K); **8451**: 7.6 (K); **8571**: 9.18 (BK-Photo); **8853**: 5.6 (K). **8888**: 4.3 (K); **8941**: 4.3 (K); **8971**: 4.3 (K); **9077**: 4.3 (K); **9108**: 6.1 (K); **9502**: 9.40 (BKF, SLR); **9620**: 6.1 (K).

Larsen *et al.* 41746: 6.1 (K); **41799**: 3.1 (PSU); **.42967**: 7.6 (PSU); **43151**: 7.6 (PSU); **43287**: 7.6 (PSU); 43704: 9.15 (K).

Larsen, Larsen, Nanakorn, Ueachirakan & Sirirugsa 41827: 9.20b (PSU); 41878 : 9.20b (PSU); 41907: 9.32 (PSU); 41910: 9.20b (PSU); 41969: 6.1 (PSU).

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Larsen, Larsen, Niyomdham, Sirirugsa, Tirvengadum & Norgaard 43488: 3.1 (PSU); 43165: 9.15 (BKF); 43741: 9.12 (PSU); 43150 : 7.6 (BKF).

Larsen, Santisuk & Warncke 3024: 7.3 (BKF, K).

Larsen, Tange & Sookchaloem 46333: 9.1 (BKF).

Lasen & Warncke 4873: 9.40 (BKF).

Lasen, Lasen, Renner, Niyomdham, Ueachirakan & Sirirugsa 42957: 5.6 (BKF).

Lasen, Tange & Sookchaloem 4624: 9.40 (BKF); 46924: 9.40 (BKF).

Lindhard s.n.: 5.6 (K); **s.n.**: 9.7a (K); 54: 9.40 (K).

Loresler Hanid3837: 9.32 (K).

Luang Vanpruk 354: 9.47 (BKF, K).

M.van de Bult 817: 9.23 (BKF).

Marcan s.n. : 7.7(BM); **54**: 7.6 (BM); **99**: 9.45 (K); **500**, **501**: 7.6 (K); **546**: 5.6 (K); **559**: 9.45 (K); **1525** : 4.6(BK); **1578** : 9.41 (BK, BM, K).

Maxwell, J. F. 70-6: 9.45 (BK); **70-11**: 5.2 (BK); **70-99**: 5.2 (BK); **71-117**: 5.2 (BK); **71-509**: 9.42 (BK); **71-677**: 9.47 (BK); **71-686**: 3.1 (BK); **72-87**: 9.47 (BK); **72-445**: 5.3 (BK); **73-22**: 4.5 (BK); **74-129**: 9.45 (BK, BKF); **74-996**: 5.3 (BK); **74-1030**: 5.3 (BK); **73-749**: 5.3 (BK, BKF); **73-767**: 9.7a (BK); **73-770**: 3.1 (BK); **76-23**: 9.41 (BK); **76-44**: 9.40 (BK); **76-47**: 4.3 (BK); **76-52**: 9.24(BK); **76-79**: 5.2 (BK); **84-61**: 9.32 (PSU); **85-19**: 9.32 (PSU); **85-76**: 5.6 (BKF, PSU); **85-156**: 6.1 (BKF, PSU); **85-557**: 7.6 (PSU); **86-125**: 9.36 (BKF, PSU); **86-785:** 7.6 (BKF, PSU); **86-947**: 5.6 (BKF, PSU); **87-1460**: 9.40 (BKF); **87-1563**: 6.1(BKF); **87-1586**: 9.5 (BKF); **87-203**: 6.1 (PSU); **87-37**: 5.6 (BKF, PSU); **87-38**: 5.6 (PSU); **87-50**: 5.6 (BKF, PSU); **87-540**: 7.6 (BKF, PSU); **87-62**: 5.2 (BKF); **87-62**: 5.2 (PSU); **87-64**: 5.6 (PSU); **87-97**: 9.32(PSU); **88-1197**: 9.31 (BKF); **88-1210**: 9.46 (BKF); **88-139**: 9.45 (BKF); **89-10**: 6.1 (BKF); **89-104**: 9.24 (BKF); **89-105**: 9.44a (BKF); **89-119**: 6.1 (BKF); **89-30**: 9.24 (BKF); **89-326**: 9.1 (BKF); **89-53**: 9.1 (BKF) **93-1037**: 7.7 (BKF, CMU); **93-1398**: 9.30 (BKF-2 dup.); **93-1406**: 9.20b (CMU); **93-1406**: 9.47 (BKF); **93-1421**: 9.7a (BKF); **93-1499**: 9.9 (CMU); **93-15**: 9.20b (CMU); **93-871**: 9.33 (topotype-CMU); **93-1529**: 6.1 (BKF); **94-43**: 9.7a (BKF); **94-52**: 9.34 (BKF, CMU)**; 94-133**: 9.4 (BKF)**; 94-135**: 9.47 (BKF, CMU); **94-135**: 9.47 (BKF, CMU); **94-1087**: 7.3 (BKF, CMU); **94-1225**: 2.1 (CMU, Faculty of Sciences); **94-1262**: 9.47 (BKF, CMU); **94-1288**: 9.20b (BKF, CMU); **94-1323**: 9.4 (BKF); **95-26** : 9.47 (BKF); **95-67**

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: 6.1 (BKF)**; 95-552**: 7.3 (BKF, CMU); **95-991**: 9.13 (BKF); **95-1006**: 9.28 (BKF); **95-1029**: 7.3 (BKF, CMU); **95-1117**: 9.46 (BKF); **95-1163**: 9.22 (BKF); **95-1286** : 6.1 (BKF); **95-1301**: 9.7a (BKF); **95-141** : 9.20b (BKF, CMU); **95-210**: 9.20b (BKF, CMU); **96-18**: 9.20b (BKF, CMU); **96-40** : 6.1 (BKF); **96-43** : 9.24 (BKF); **96-62**: 9.40 (BKF); **96-87**: 9.20b (BKF, CMU); **96-139**: 9.22 (BKF); **96-202**: 7.3 (BKF, CMU); **96-249**: 9.24 (BKF); **96-1350**: 7.3 (BKF, CMU); **97-16:** 9.40 (BKF); **97-19**: 9.24 (BKF); **97-26:** 6.1 (BKF); **97-130**: 9.1 (BKF); **97-699**: 7.6 (BKF); **97-831**: 7.6 (BKF); **97-1522**: 9.5 (BKF); **98-19**: 9.20b (BKF, CMU); **98-764**: 9.47 (BKF); **00-7**: 9.40 (BKF); **00-16**: 9.4 (BKF); **00-17**: 9.39 (BKF, CMU); **00-66**: 9.20b (CMU); **00-112**: 9.41 (BKF); **00-134**: 7.2 (BKF); **02-64**: 9.47 (CMU); **03-66**: 9.21(BKF); **03-150:** 9.21(BKF); **03-294**: 7.3 (BKF, CMU); **03-428**: 2.1 (Holotype, CMU, Faculty of Sciences)**; 03-444**: 9.47 (CMU); **04-20**: 9.9 (CMU); **04-75**: 9.13 (CMU); **04-295**: 7.6 (CMU); **04-491**: 9.48 (BKF) **04-516**: 9.13 (CMU); **04-675**: 9.47 (CMU); **04-682**: 9.47 (CMU); **04-774**: 9.7a (BKF); **05-201**: 9.8 (BKF) **05-567**: 9.30 (BKF); **06-129**: 9.20b (CMU).

Middleton & Triboun 4817: 7.3 (BKF); **4819**: 9.47 (BKF).

Middleton, Chamchamroon, Lindsay, Phuphat & Pooma 3478: 3.1 (BKF).

Middleton, Chamchamroon, Lindsay, Pooma & Suwananchat 2001: 9.21(BKF).

Middleton, Karaket, Triboun, Kawatkul & Meeboonya 4512: 9.48 (BKF); **4590**: 7.3 (BKF).

Middleton, Namdang, Pooma, Suddee, Suwanachat & Williams 2258: 9.16 (BKF); 2265: 4.5 (BKF); 2468: 6.1 (BKF); 2740: 9.32 (BKF); 2761: 9.32 (BKF).

Middleton, Phuphat, Pooma&Williams 2837: 5.6 (BKF).

Middleton, Suddee & Hemrat 1576: 4.6 (K); **1588**: 9.47 (CMU).

Middleton, Sudee, Davies & Hemrat 1078: 9.47 (CMU).

Middleton, Triboun, Chamchumroon, Saengrit & Simma 4408: 9.29 (BKF).

Mitsuta T. 50241: 9.40 (BKF).

Mitsuta, Nagamasu, Yahara &Nantasan T. 42281: 9.20b (BKF).

Murata & Phengklai T. 50432: 3.1 (BKF).

Murata *et al.* T. 17232: 7.7 (BKF); **T. 42518 : 9.20b (BKF); T. 43074**: 3.1 (BKF); T. **43074**: 3.1 (BKF); **T**. **50044**: 9.40 (BKF); T. **50512**: 3.1, T. **50636**: 3.1 &T. **50432**: 3.1 (BKF); T. **51455**: 3.1 & T. **51461**: 3.1 (BKF).

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Murata, Iwatsuki & Pengklai T.15087: 9.46 (BKF); T.**15139**: 9.46 (BKF, K); T.**15174**: 9.46 (BKF); **T. 15172** : 9.47 (BKF).

Murata, Iwatsuki, Pengklai, & Charamphol T. 15744: 9.13 (BKF); T.**15743** : 9.13 (BKF); T. **15537**: 7.3 (BKF); T. **16009**: 9.20b (BKF).

Murata, Phengklai, Mitsuta, Nagamasu & Nantasan T. 52634 (BKF).

Murata, Phengklai, Mitsuta, Yahara, Nagamasu & Nantasan T. 38289: 3.1, **T. 38434**: 3.1, **T. 38446** & **T. 38468**: 3.1 (BKF); T. **41999**: 9.20b (BKF); T. **42516**: 9.30 (BKF); T. **43025**: 9.40 (BKF); T. **43129**: 9.30 (BKF); T. **51375**: 9.45 (BKF); T. **51510**: 3.1 (BKF); T. **51682**: 9.24 (BKF); T.**50759**: 9.7a (BKF); T. **40239**: 9.20b (BKF).

Nai Klean s.n.: 5.3 (BK).

Nai Noe s.n. : 9.16 (BM).

Nielson, Pooma, Koonkhunyhod & Poopath 1815: 9.47 (BKF).

Nimanong & Phusomsaeng 111: 9.30 (BKF, K); **115**: 9.24 (BKF, K).

Niyomdham & Puudjaa 4676: 9.30 (BKF –2 dup.).

Niyomdham & Vidal 442: 9.22 (BKF); **501**: 9.22 (BKF-2 dup., SLR); **502**: 9.20b (BKF).

Niyomdham & Kubat 1390 : 9.32(BKF, K, SLR).

Niyomdham 903: 7.3 (BKF), 3066 : 9.21(BKF); 6391 : 9.7a (BKF-2 dup.).

Niyomdham *et al*. 2338: 9.21(BKF);

Niyomdham, Suangtho & Sangkhachand 91: 9.7a (BKF, K); 149: 9.20b (BKF-2dup., K).

Nooteboom & Phengklai 635: 9.20b (BKF, K).

Nooteboom, Tantisewie & Phenklai 635: 9.20b (BKF)

Nunchuai 1325: 9.46 (BKF).

Ohkubo A 220: 9.1 (BKF).

Paisooksantiwatana, Y. 83-79: 9.13 (BK-2 dup., CMU); **564-81**: 5.5 (BK-2 dup.); **1453-84**: 9.1 (BK); **1547-85**: 5.6 (BK); **1765-86**: 9.24 (BK); **1884-86**: 9.13 (BK); **1765-86**: 9.24 (BK); **2029-87**: 9.47 (BK); **2600-89**: 5.6 (BK).

Paisooksantivathana & Penchit 1241-83: 9.20b (BK).

Palee 115: 7.6 (BKF); **791** : 9.20b (CMU).

Panatkool 106: 9.20b (CMU); **269**: 7.7 (CMU); **439**: 7.3 (CMU).

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Parinya & Santi 359: 9.41 (SLR); **369** : 9.11 (SLR); **402** : 4.6 (SLR-2 dup.); **407** : 9.41 (BK).

Petrmitr 80: 7.6 (BKF); **127**: 9.40 (BKF); **237**: 6.1 (BKF); **237**: 6.1 (BKF); **248**: 9.7a (BKF); **376**: 9.7a (BKF).

Phengklai & Fukuoka 10096 : 9.21(BKF- 3 dup.,SLR); **10128**: 7.3 (BKF, SLR)

Phengklai 290: 9.40 (BKF); **3961**: 7.3 (BKF); **12261**: 9.9 (BKF-3 dup., SLR).

Phengklai *et al.* 7227: 7.7 (BKF); **7275**: 9.21 (BKF, SLR); **7317** : 9.21(BKF); **7514** : 9.21(BKF, SLR); **9005**: 9.40 (BKF, SLR); **14057**: 7.3 (BKF); **14083**: 7.3 (BKF-2 dup.).

Phengklai, Tamura, Niyomdham & Sangkachand 4066: 9.21 (BKF, K, PSU).

Phengnaren s.n.: 9.24 (BKF).

Phoenchit 11: 9.40 (BKF, SLR); 44: 4.6 (K).

Phongrounkeit 362: 7.7 (CMU).

Phonsena, Chusithong & Chausook 6142: 9.1 (BKF).

Phra Vanpruk 489: 9.47 (K)

Phusomsaeng & Pinnin78: 6.1(BKF, K).

Phusomsaeng 56: 4.4 (K); 58: 9.46 (BKF).

Ploenchit 392: 9.21(BKF, K).

Pooma 370: 9.30(BKF); **580**: 9.47 (BKF, CMU); **614**: 9.44b (BKF); **669** : 9.21(BKF); **689**: 9.30 (BKF); **889**: 9.1 (BKF); **893**: 9.20b (BKF); **994**: 9.43 (BKF); **1176**: 9.10 (BKF, SLR); **1242**: 9.20b (BKF); **1251**: 9.7a (BKF); **1307**: 9.7a (BKF); **5692**: 9.18 (BKF).

Pooma, Berg & Poopath 5815 : 9.7a (BKF); **5818**: 3.1 (BKF).

Pooma, de Wilde, Duyfjes, Chamchumroon & Phattarahirankanok 2383: 3.1 (BKF); **2749**: 3.1 (BKF).

Pooma, Karaket & Sirimongkol 6819: 9.24 (BKF).

Pooma, Patthaahirantricin & Sirimongkol 6523: 9.36 (BKF); 6647: 5.2 (BKF); 6647: 5.2 (BKF).

Pooma, Phattarahirankanok, Sirimongkok & Poopath 4999: 9.11 (BKF); **6007**: 3.1 (BKF); **6036**: 9.11 (BKF).

Poopath, Puff, Tanaros & Putthai 6151: 4.3 (BKF); 6204: 4.4 (BKF).

Porkar 16: 7.7 (BKF, CMU).

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Pradatsunthornsarn 14: 5.6 (BK).

Pradit 613: 3.1 (BK); **725**: 5.4 (BK).

Prayad 512: 9.41 (BK); **553**: 3.1 (BK); **677**: 9.20b (BK); **1011**: 3.1 (BK); **1067**: 9.30 (BK); **1110**: 9.30 (BK) **1153**: 5.3 (BK); **1180**: 4.3 (BK); **1200**: 9.20b (BK); **1347**: 5.6 (BK).

Premrasmi s.n.: 9.32 (BKF).

Pruesapan *et al.* KP-22: 5.6 (SLR).

Put s.n.: 5.2 (BK, BM); **s.n**.: 5.3 (BK); **372**: 9.14 (BM, holotype-K); **570**: 9.35 (BK); **2328**: 5.2 (BK, K); **2330**: 4.3 (BK, K); **2370**: 9.34 (K); **2535**: 5.2 (BK, BM, K); **2548**: 5.3 (BK, K); **2592**: 5.3 (K); **2940**: 9.21 (BK, BM, K); **3229** : 9.47 (BK, K); **3302**: 9.22 (BK, type *S. suborbiculata*-BM, K); **3313** : 9.20b (BK, BM, K); **3331**: 9.6 (BK, BM,type-K); **3425**: 9.47 (BK, BM, K); **3511**: 9.1 (BK, BM, K); **3873**: 9.47 (K); **4235**: 3.1 (BK, K); **4321**: 9.40 (K); **4369**: 7.3 (type *R. subulata*-BK, K); **4393** : 9.24(K); **4430**: 4.6 (BK, K); **4460**: 9.5 (BM, K).

Puudjaa 330: 9.32 (BKF); **353**: 5.6 (BKF); **871**: 9.11 (BKF-2 dup.).

Puujaa, Chuenchomglin & Hemrat 1558: 9.1 (BKF).

Rock 1806 : 9.20b (K).

S. & J. 1958: 9.41 (BK); **2107**: 4.4 (BK).

S.P. **72**: 9.40 (BKF, SLR).

S.P. *et al.* 81: 3.1 (BKF).

S.P., N.S. & Samrong 6: 9.38 (BKF); **407**: 9.10 (BK).

Sadakorn 289: 9.47 (BK); **389**: 5.2 (BK); **445**: 9.20b (BK); **649** : 9.30 (BK).

Sai Jai 11: 9.33 (BKF, paratype-CMU).

Sakol 185: 5.4 (BK);

Samsong 6: 9.1 (BKF- 2 dup.)

Sanan 88: 3.1 (BKF);

Sankemethawee 288: 9.40 (BKF); **364**: 9.5 (BKF); **366** : 9.7a (BKF); **386**: 9.20b (BKF, CMU); **397**: 5.2 (BKF).

Sanoh 764: 3.1 (BKF);

Santisuk s.n.: 9.5 (BKF, SLR); **s.n**.: 9.20b (BKF); **s.n**.: 9.24 (BKF); **593** : 9.37(BKF- 2 dup.); **1032**: 9.21 (BKF); **1467** : 9.20b (K); **1508**: 9.7a (K); **1614** : 9.48

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(BKF, SLR); **6651**: 9.7a (BKF); **6671**: 9.5 (BKF, SLR); **6838** : 9.29 (BKF-2 dup.); **6892**: 4.6 (SLR); **6894**: 6.1 (BKF); **6927**: 9.38 (BKF-2 dup.).

Schomburgk 200: 7.6 (K).

Shigeyuki, Nisuta, Hidetoshi & Naga T. 40239: 9.20a (BK)

Shimizu *et al.* T. 10615: 7.3 (BKF); **T. 17978**: 7.6 (BKF); T. **17978**: 7.6 (BKF); **T. 18377**: 3.1 (BKF-2 dup.); T. **18428**: 9.47 (BKF, K); T. **18496**: 9.26 (K); T. **19442** : 7.6 (BKF-2 dup.); T. **19648** : 9.21(BKF); T. **20581** : 9.21(BKF); T. **21379**: 7.3 (BKF-2 dup.); T. **21379**: 7.3 (BKF-2 dup.); T. **21764** : 7.3 (BKF-2 dup., K); T. **21794**: 7.3 (BKF-2 dup.); T. **21834**: 7.3 (BKF-2 dup.); T. **22270** (BKF-2 dup.); T. **22275**: 3.1 (BKF); T. **22306**: 7.3 (BKF); T. **22410**: 7.3 (BKF); T. **23219**: 9.20b (BKF); T. **26230** : 6.1(BKF); T. **26673**: 9.33 (K) T. **27148** : 6.1(BKF); **T. 26739**: 9.20b (BKF); **T. 26841**: 9.20b (BKF); **T. 26887**: 9.20b (BKF); T. **27304**: 6.1 (BKF-2 dup.); T. **27313** : 6.1 (BKF -2dup.); T. **27353**: 6.1 (BKF); **T. 27364**: 6.1 (BKF-2 dup.).

Shimizu & Hutoh T. 10152: 9.47 (BKF).

Shimizu, Toyokuni, Koyama, Yahara & Niyomdham T. 26211: 6.1 (BKF-2dup.).

Shimizu, Iwatsuki, Fukuoka & Hutoh M.12965: 8.1 (BKF).

Shimizu, Iwatsuki, Fukuoka, Hutoh, Chaiglom & Nalampoon T. 11574: 9.20b (BKF).

Shimizu, Koyama & Fukuoka T. 5743: 7.7 (BKF).

Shimizu, Koyama & Nalampoon T. 10801: 7.6 (BKF); **T. 10805**: 7.3 (BKF-2 dup., K); **T. 10861**: 7.3 (BKF).

Shimizu, Toyokuni, Koyama, Yahara & Santisuk T.18097: 9.9 (BKF, K); **T.18496**: 9.43 (BKF);

Shimizu, Toyokuni, Koyama & Niyomdham 26673: 9.2 (BKF).

Shimizu, Toyokuni, Koyama, Yahara & Niyondham T. 17965: 7.6 (BKF-2 dup.); **T. 18101**: 9.21(BKF); **T. 18357**: 3.1(BKF-2 dup.); **T. 18630**: 9.20b (BKF) **T. 18775**: 9.20b (BKF); **T 18827**: 9.13 (BKF-2 dup., K); **T.18897**: 9.21(BKF); **T. 18945**: 9.48 BKF, K); **T. 19333**: 9.7a (BKF); **T. 19427**: 7.7 (BKF); **T. 19561**: 9.21 (BKF); **T. 20580**: 9.46 (BKF); **T.20581**: 9.21(BKF); **T. 20601**: 9.21(BKF); **T. 20603**: 9.20b (BKF); **T. 21719**: 7.6 (BKF); **T. 22377**: 7.3 (BKF-2 dup.); **T. 22632**: 9.40 , **T. 22656**: 9.40 (BKF); **T. 22708**: 3.1 (BKF-2 dup.); **T. 22972**: 9.5 (BKF); **T. 23091**: 9.20b (BKF); **T. 26223**: 9.32(BKF); **T. 26398**: 9.37(BKF); **T. 26560**: 9.43 (BKF); **T.**

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26660, **T. 26691**: 9.36 (BKF); **T. 26724**: 9.20b (BKF); **T. 26727**: 9.32 (BKF – 2 dup.); **T. 26811**: 9.36 (BKF); **T. 26901**, **T.26740**, **T. 26595**, **T. 26685**: 9.21 (BKF); **T.26560**, **T. 26556**: 9.27 (BKF); **T. 27760**: 7.7 (BKF-2 dup.).

Shimizu, Toyokuni, Koyama, Yahara & Phanichaphol T. 23509 : 9.41 , **T. 23574** : 9.41 (BKF); **T. 23940**: 9.21(BKF).

Shimizu, Toyokuni, Koyama, Yahara Santisuk & Niyomdham T. 20916: 9.46, **T. 20919**: 9.46, **T. 20943**: 9.46 (BKF); **T. 20950**, **T. 21118**, **T. 21145**: 9.22 (BKF).

Singhasthit 325: 9.7a (BKF, K).

Sirijaraya 21: 5.2 (BK).

Sirirugsa 637: 7.6 (PSU); **726**: 5.6 (PSU); **959**: 6.1 (PSU); **991**: 7.6 (PSU); **1145**: 9.12 (PSU); **1154**: 5.6 (PSU); **1156**: 5.6 (PSU); **1157**: 5.6 (PSU).

Smithinand s.n.: 7.7 (BKF); **s.n.**: 9.5 (BKF); 9.16 (BKF); **s.n**.: 9.22 (BKF- 2 dup.); **s.n**. : 9.46 (BKF); **77**: 9.30 (BKF, K, SLR); **83**: 5.2 (BKF); **86-15**: 9.40 (BKF); **827**: 9.21 (BKF); **3981**: 9.7a (BKF, K); **3985**: 9.30 (BKF, K); **4301**: 4.6 (K); **4312**: 6.1 (BKF, K); **4428**: 9.50 (BKF); **4893**: 3.1 (BKF); **4893**: 3.1 (K); **4914**: 9.40 (K); **7568**: 7.3 (BKF); **8480**: 9.24 (BKF); **8505**: 9.40 (BKF, SLR); **8511**: 7.6 (BKF); **8743**: 9.20b (BK, BKF); **10253**: 5.2 (BK, BKF, K); **11844**: 9.5 (BKF); **12024**: 9.32 (BKF); **12221**: 9.5 (BKF).

Smitinand & Boonkird 11416: 9.7a (BKF); **11417**: 9.24 (BKF); **11425**: 6.1 (BKF); **11422**: 9.11 (BKF, SLR); **11438**: 9.5 (BKF).

Smitinand& Anderson7305: 9.22 (BKF- 2 dup.).

Smitinand & Phengklai 8811: 7.6 (BKF).

Smitinand & Phoenchit 187: 9.31 (BKF).

Smitinand & Robbins7890: 9.41 (BKF, K).

Smitinand & Saphasi10682: 4.6 (K); **10697**: 9.40 (BKF).

Smithinand & Sleumer 1188: 7.6 (BKF); **8329**: 9.21(BKF, K-2 dup.)

Smitinand, Poore & Robbins 7791: 9.46 (BKF).

Song See 4: 9.45 (BKF, PSU); **43**: 7.7 (PSU).

Sorensen, Larsen & Hansen 320: 9.35 (BKF); **907**: 9.7a (BKF); **1766**: 5.5 (BKF); **5378**: 9.5 (BKF); **5663**: 9.30 (BKF); **6462**: 5.2 (BKF); **7047**: 5.2 (BKF) **1004**: 9.40 (BKF); **1944**: 9.45 (BKF); **2009**: 7.7 (BKF); **2011**: 9.50 (BKF); **6134**: 3.1 (BKF); **6497**: 9.7a (BKF).

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Suddee, Trisarasri, Thanaros, Hemrat & Suwannachat 2953: 9.10 (BKF)

Sukkri 74: 9.46 (BKF).

Sutheesorn & Sadakorn 1974: 5.4 (BK); **2005**: 5.6 (BK).

Sutheesorn 1434: 5.5 (BK); **1444** : 9.20b (BK); **1530**: 4.6 (BK-2 dup.); **2123**: 5.3 (BK); **2218** : 5.6 (BK); **2237**: 9.24 (BK); **2259** : 9.20b (BK); **2303**: 9.10 (BK); **2704**: 5.3 (BK); **2782**: 5.4 (BK); **2795**: 5.4 (BK); **2813**: 5.2 (BK); **2985**: 5.6 (BK-2 dup.); **3160**: 5.2 (BK); **4004**: 4.6 (BK); **5254**: 9.24 (BK).

Suvanakoses 59: 9.7a (BKF, K); **85**: 9.40 (BKF, K); **987**: 9.40 (BKF, K); **1031**: 9.16 (BKF, K); **2003**: 4.6 (K).

Suvanasuddhi s.n. : 9.49 (BK-2 dup.); **379**: 9.41 (SLR).

Suvarnabhadhu 380: 9.47 (BKF); **381**: 9.1 (BKF).

Tagawa & Fukuoka T. 2114: 6.1 (BKF, K);

Tagawa & Kitagawa T. 3865: 9.20b (BKF).

Tagawa, Iwatsuki & Fukuoka T. 481: 9.30 (BKF); **T. 491**: 9.20b (BKF); **T. 897**: 9.40 (BKF); **T. 1076**: 9.9 (BKF); **T. 1224**: 9.46 (BKF, K); **T. 1814**: 9.15 (BKF, K); **T. 2231**: 6.1 (BKF); **T. 4155**: 9.31 (BKF); **T. 4163**: 9.31 (BKF); **T. 4425**: 9.24 (BKF); **T. 5328**: 9.21(BKF); **T. 6743**: 9.32 (BKF); **T. 7585**: 7.7 (BKF); **T. 9924**: 9.47 (K).

Tagawa, Iwatsuki, Koyama & Chintayungkun T. 8666: 7.3 (BKF).

Tagawa, Shimizu, Hutoh, Koyama & Nalampoon T. 9924: 9.47 (BKF).

Tagawa, Shimizu, Koyama & Nalampoon T. 10622: 7.3 (BKF).

Tagawa, Iwatsuki & Fukuoka Sutheesorn T. 4039: 9.10 (BKF).

Takahashi & Tamura T.63463: 9.13 (BKF).

TDBS 10833: 9.20b (BK, BKF); **10872**: 9.47 (BK); **11031**: 4.3 (BK).

Terao T. 30289: 7.6 (BKF).

Terao & Wongprasert T. 31190: 9.45 (BKF, K).

Terao, Niyomdham & Wongprasert T. 30511: 7.3 (BKF).

Thaya s.n.: 4.6 (SLR); **1257**: 9.47 (SLR); **1318**: 4.3 (SLR); **1362**: 9.45 (SLR).

Thongisan 38: 9.20b (CMU); **43** : 9.20b (CMU).

Tipabiankarn s.n.: 4.3 (SLR); **1644** : 9.50 (SLR); **2302**: 9.25 (SLR); **4484**: 6.1 (SLR).

Umpai 88: 9.42 (BK); **115** : 9.20b (BK); **315**: 9.20b (BK); **326**: 9.41 (BK).

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Vacharapong 13: 5.6 (BK); **106**: 5.2 (BK); **169**: 9.32 (BK); **186**, **190** : 9.37(BK); **229**: 4.3 (BK); **250**, **251**, **252**: 5.2 (BK); **323**: 9.41 (BK).

Vacharee & Santi 13: 9.45 (SLR).

van Beusekom & Geesink 3381 : 9.41 (BKF).

van Beusekom & Phengkhlai 22: 9.41 (BKF, K, SLR); **302**: 9.9 (BKF, K); **2332**: 9.30(BKF); **2377**: 9.20b (BKF).

van Beusekom & Smitinand 2118: 9.2 (BKF); **2126**: 5.6 (BKF); **2185**: 9.1 (BKF).

van Beusekom, Phengklai, Geesink & Wongwan 3915: 7.3 (BKF); **3938**: 5.2 (BKF); **3972** : 6.1(BKF, K); **4169** : 6.1(BKF, K); **4327**: 9.47 (BKF, K); **4630**: 9.47 (BKF, K); **4707**: 6.1 (BKF, K); **4765**: 9.40 (BKF).

van de Bult 40: 7.3 (BKF); **177** : 9.47 (BKF); **468**: 7.3 (BKF); **704**: 9.30 (BKF); **720**: 9.19 (BKF-2 dup., CMU).

Vidal 5200: 9.46 (BKF); **5339B**: 9.7a (BKF).

Vidal, Y. Vidal & Niyomdham 6245: 9.13 (BKF); **6360**: 9.21(BKF, K).

W.N. 289: 7.3 (BKF); **1064**: 9.20b (BKF).

Wattanachai 187: 7.7 (CMU).

Wattananupong 2: 7.6 (PSU).

Webb 15: 9.19 (CMU).

Winai & Santi 21: 9.45 (BK).

Winit 653: 9.7a (BK-2 dup., K); **817**: 9.16 (BKF); **1231**: 9.5 (type-BK,BKF); **1815**: 9.5 (BKF); **1818** : 9.7a (type *S. incisus*-BK, BKF); **1889**: 9.7b (BK, BKF, K).

Wongprasert & Khaolam 031-19: 9.20b (BKF).

Wongprasert s.n.: 9.20b (BKF); **032-07**: 5.2 (BKF); **37**: 9.40 (BKF); **712-9**: 9.47 (BKF- 2 dup.); **0712-11**: 9.7a (BKF).

Worawoat 59: 9.20b (BKF); **91**: 9.20b (BKF).

Wynn-Jones 7206: 9.20b (CMU).

Yahara T. 50159: 9.40 (BKF).

Zimmermanns.n.: 5.6 (K).

Zungsonthiporn, S. 384: 4.2 (Weed-Agriculture Department).

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Appendix Figure 2 Ruelliinae, Acanthaceae in Thailand. A=*Dyschoriste erecta* (Burm. f.) Kuntze; B=*Eranthemum macrophyllum* Wall. ex Nees; C=*E. suffruticosum* Roxb; D=*E. tetragonum* A. Dietr. ex Nees

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Appendix Figure 3 Ruelliinae, Acanthaceae in Thailand. A=*Hygrophila corymbosa* (Blume) Lindau; B=*Phaulopsis dorsiflora* (Retz.) Santapau; C=*Ruellia kerrii* Craib; D=*R. repens* L.

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Appendix Figure 4 Ruelliinae, Acanthaceae in Thailand. A=*Ruellia simplex* C.Wright; B=*R. tuberosa* L.; C=*Sanchezia oblonga* Ruiz & Pav.; D=*Strobilanthes abbreviata* Y.F. Deng & J.R.I. Wood

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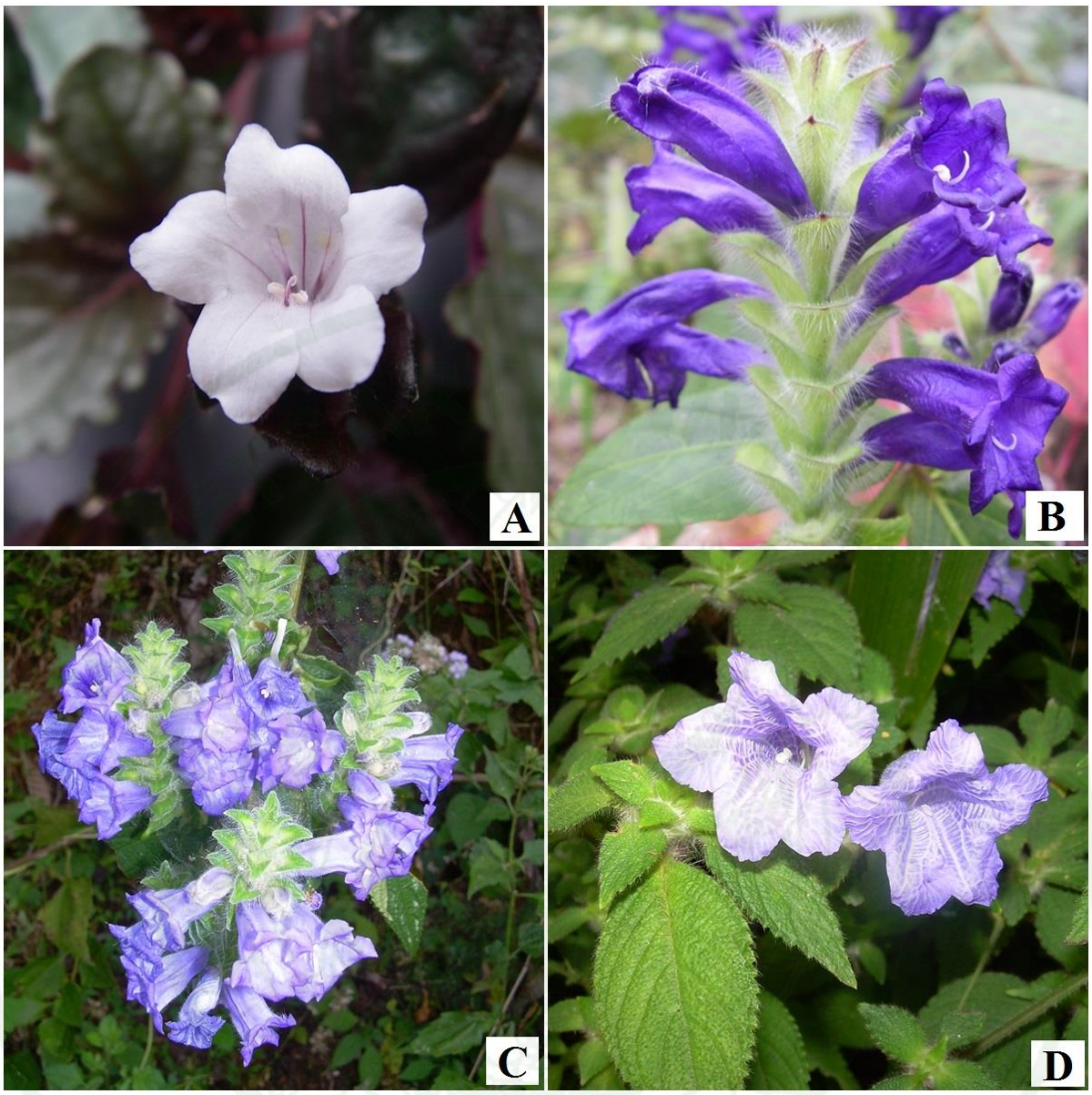

Appendix Figure 5 Ruelliinae, Acanthaceae in Thailand. A=*Strobilanthes alternata* (Burm. f.) P. Charoenchai, unpublished; B-C=*S. auriculata* Nees var. *auriculata* D= *S. brandisii* T. Anderson

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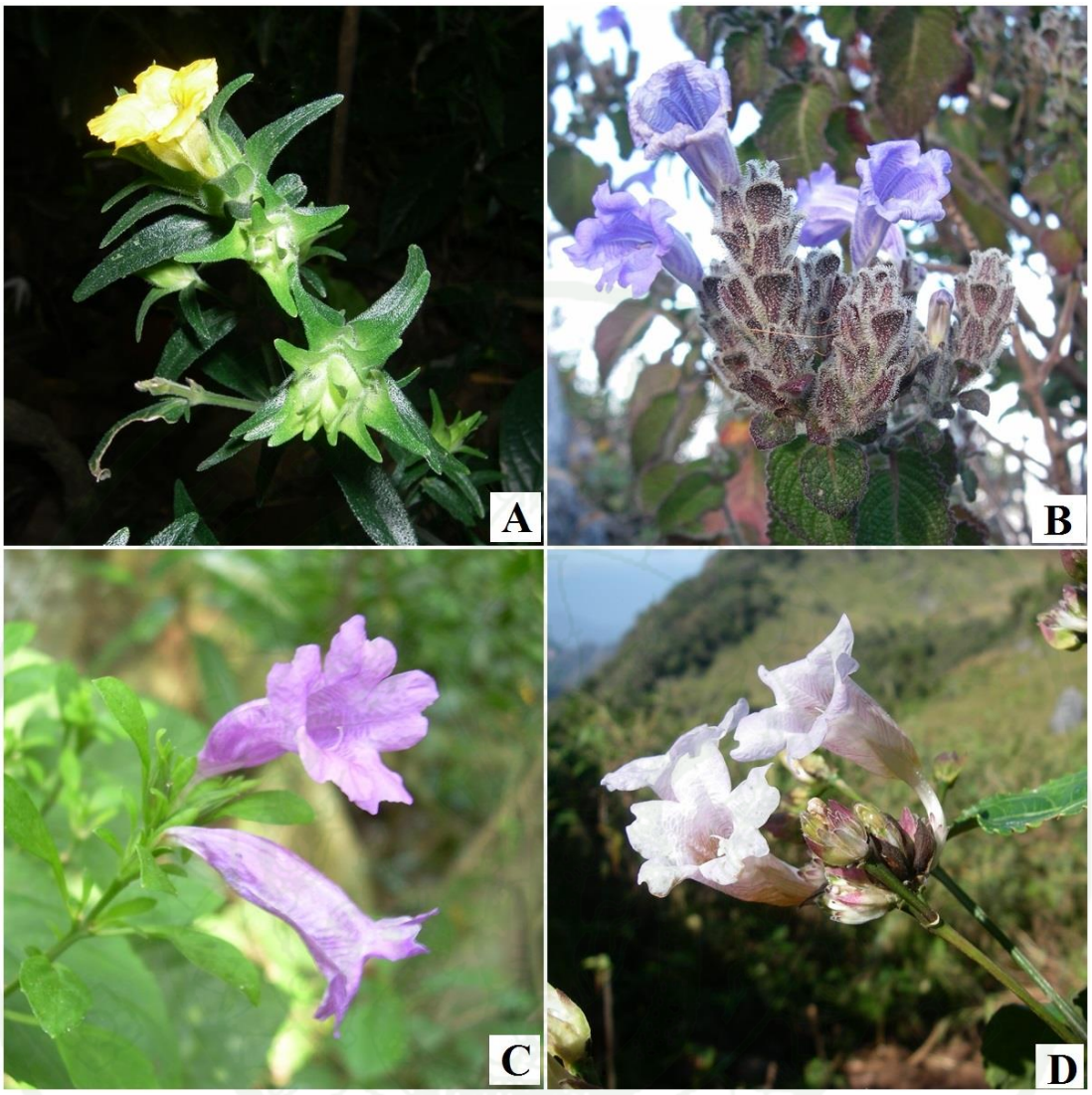

Appendix Figure 6 Ruelliinae, Acanthaceae in Thailand. A=*Strobilanthes chinensis* (Nees) J.R.I. Wood & Y.F. Deng; B=*S. corrugata* J.B. Imlay; C=*S. cusia* (Nees) Kuntz; D= *S. dimorphotricha* Hance. subsp. *rex*

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Appendix Figure 7 Ruelliinae, Acanthaceae in Thailand. A=*Strobilanthes glaucescens* Nees; B=*S. hamiltoniana* (Steudel) Bosser & Heine; C=*S. imbricata* Nees; D=*S. karensium* Kurz

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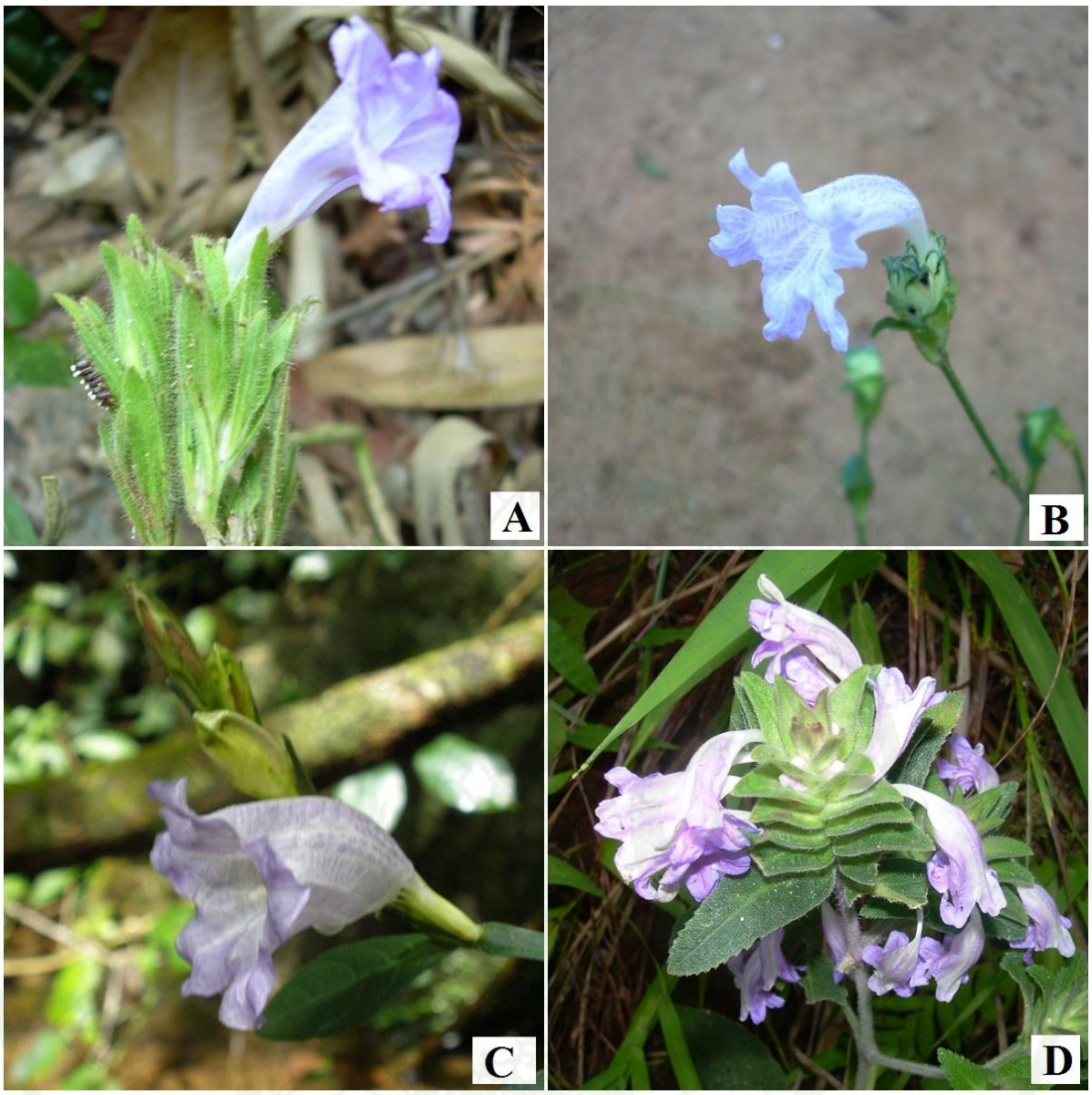

Appendix Figure 8 Ruelliinae, Acanthaceae in Thailand. A=*Strobilanthes maxwellii* J.R.I. Wood; B=*S. paniculata* T.Anderson; C=*S. pateriformis* Lindau; D=*S. quadrifaria* (Wall. ex Nees) Y.F. Deng

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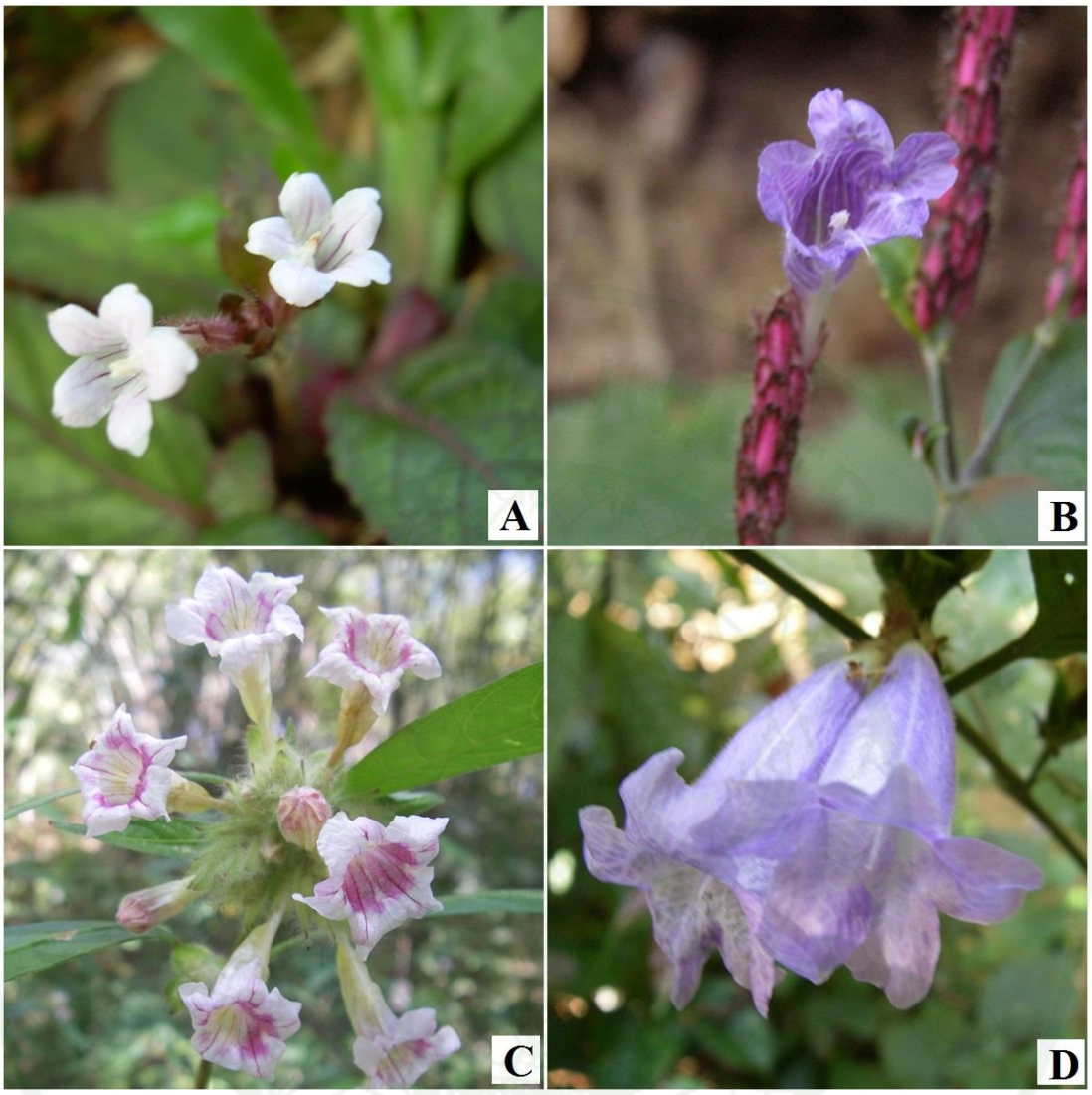

Appendix Figure 9 Ruelliinae, Acanthaceae in Thailand. A=*Strobilanthes reptans* (G. Forst.) Moylan ex Y.F. Deng & J.R.I. Wood; B=*S. repanda* (Blume) J.R. Bennett.; C=*S. schomburgkii* (Craib) J.R.I. Wood; D=*S. serrata* J.B. Imlay

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Appendix Figure 10 The specimen of *Clarkesia parviflora* (T.Anderson) J.R.I. wood (from Chermsirivathana no. 1585)

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Appendix Figure 11 *Holotype* of *Diceratotheca bracteolata* J.R.I. Wood & Scotland (from Maxwell no. 94-1225)

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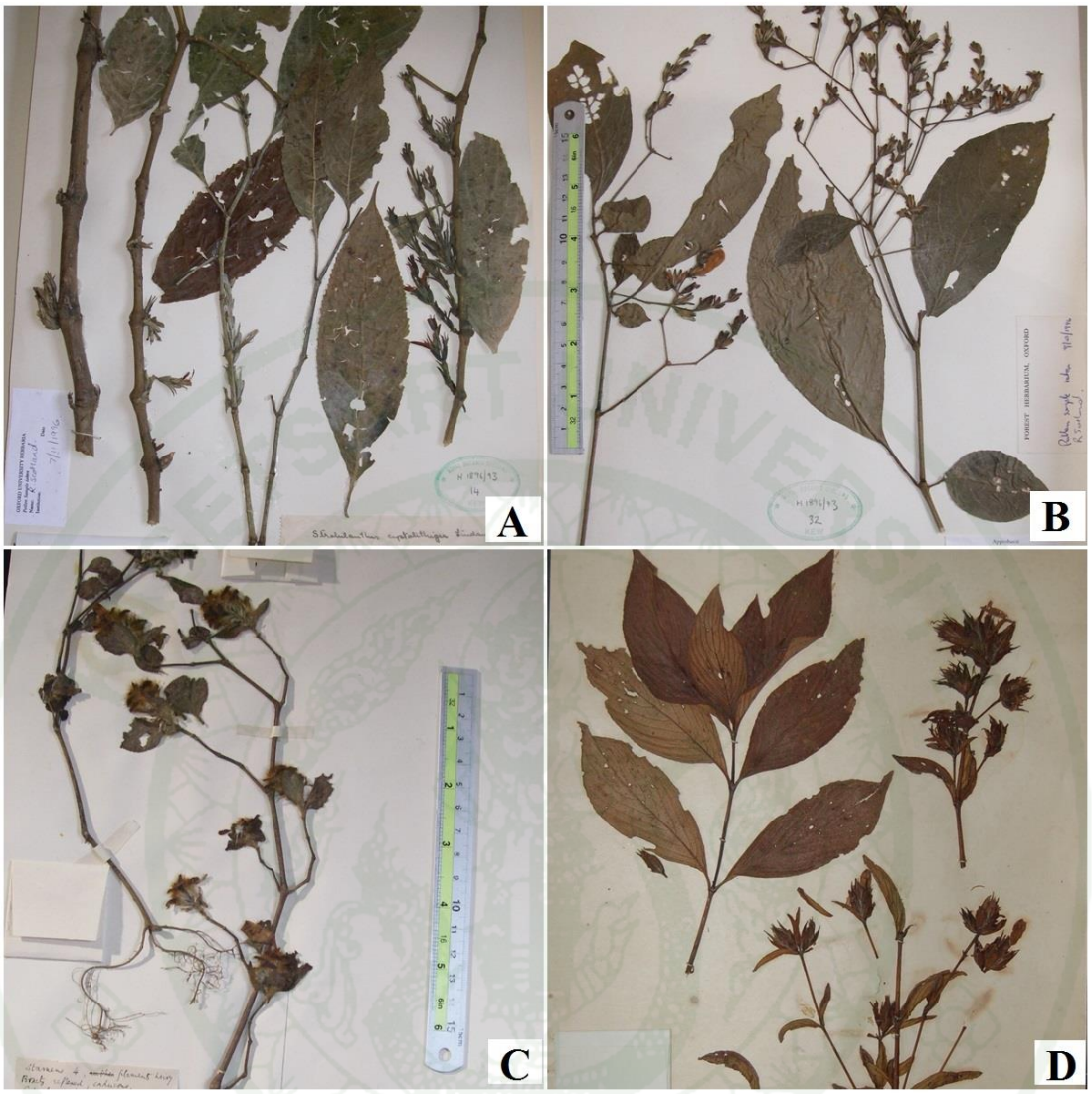

Appendix Figure 12 Plant specimens of Ruelliinae, Acanthaceae: A=*Strobilanthes abbreviata* Y.F. Deng & J.R.I. Wood (from Kerr no. 9908); B=*S. albovirdis* J.B. Imlay ((from Kerr no. 18675); C= *S.anmitica* Kuntze; D=*S. aprica* (Hance) T. Anderson (from Winit no. 1231)

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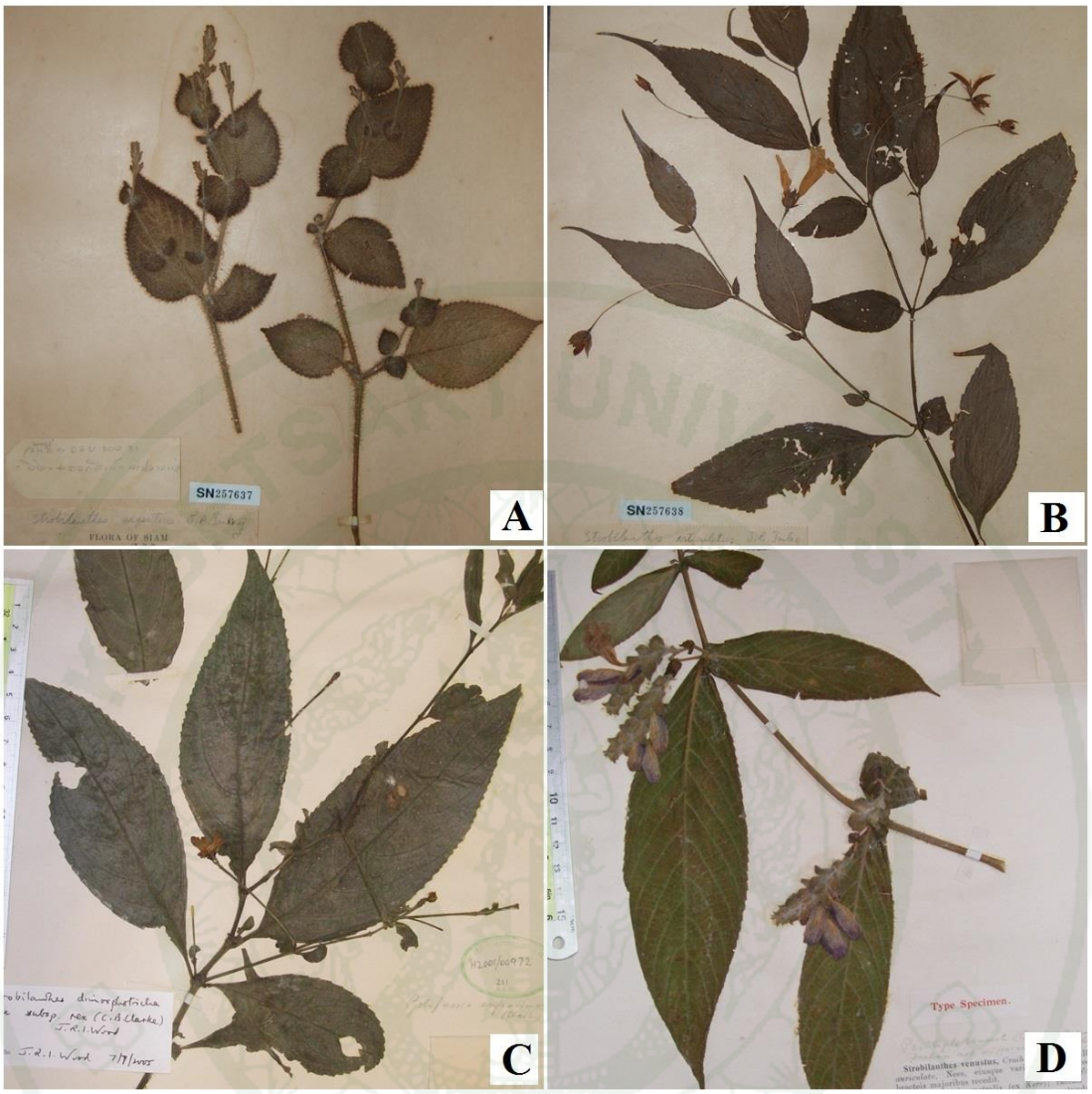

Appendix Figure 13 Plant specimens of Ruelliinae, Acanthaceae: A= *Strobilanthes argentea* J.B. Imlay (from Winit no. 3331) ; B= *S. dimorphotricha* Hance subsp. *dimorphotricha* (from Kerr no. 9630); C= *S. dimorphotricha* Hance subsp. *rex* (from Hosseus no. 336); D=*S. auriculata* Nees var. *auriculata* (from Kerr no. 2296)

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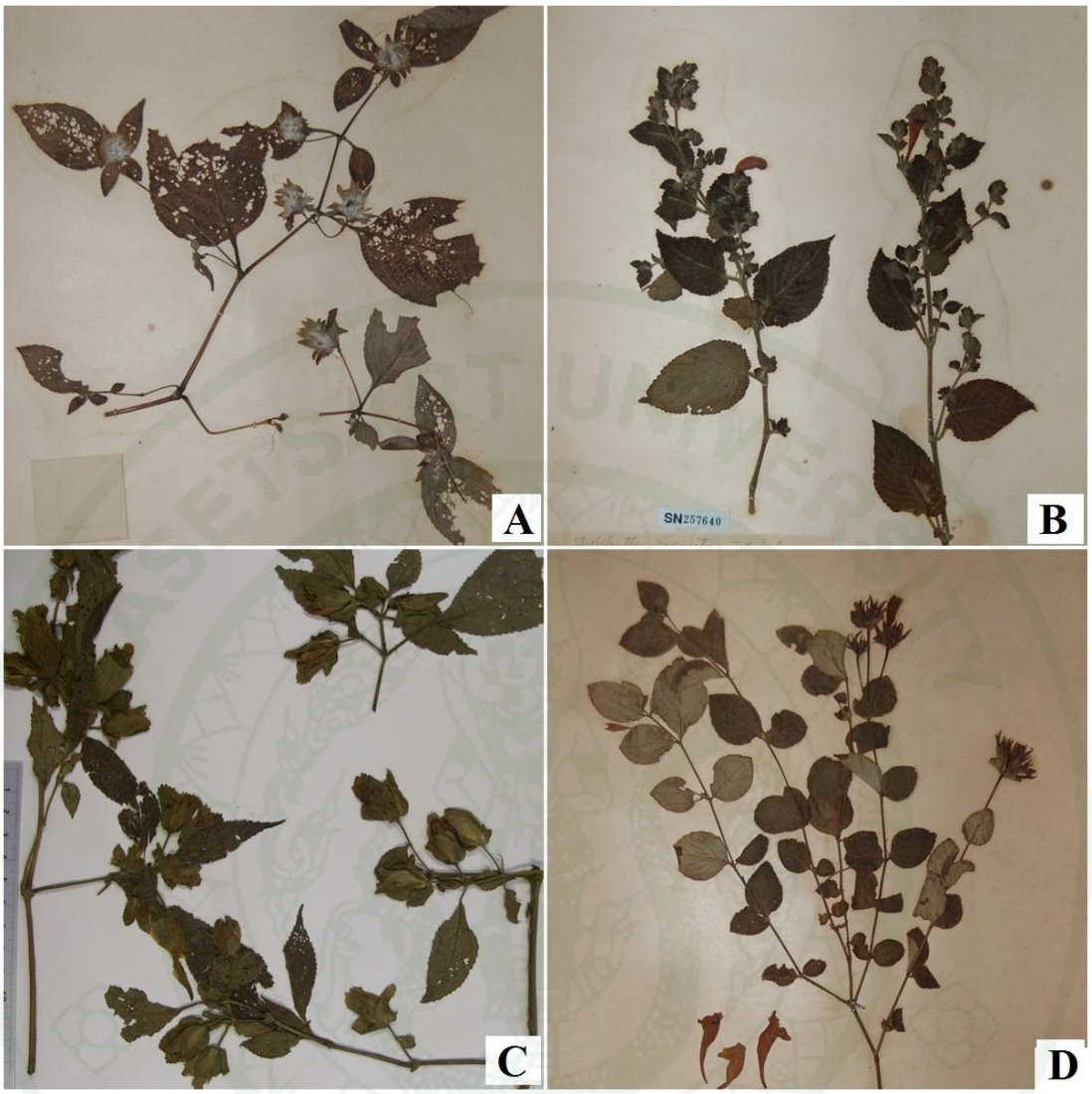

Appendix Figure 14 Plant specimens of Ruelliinae, Acanthaceae: A= *S. brandisii* T. Anderson (from Kerr no. 10211); B=*S. corrugata* J.B. Imlay (from Put no. 372); C=*S. echinata* Nees (from Iwatsuki *et al.* T. 9572); D=*S. erecta* C.B. Clarke (from Put no. 3302)

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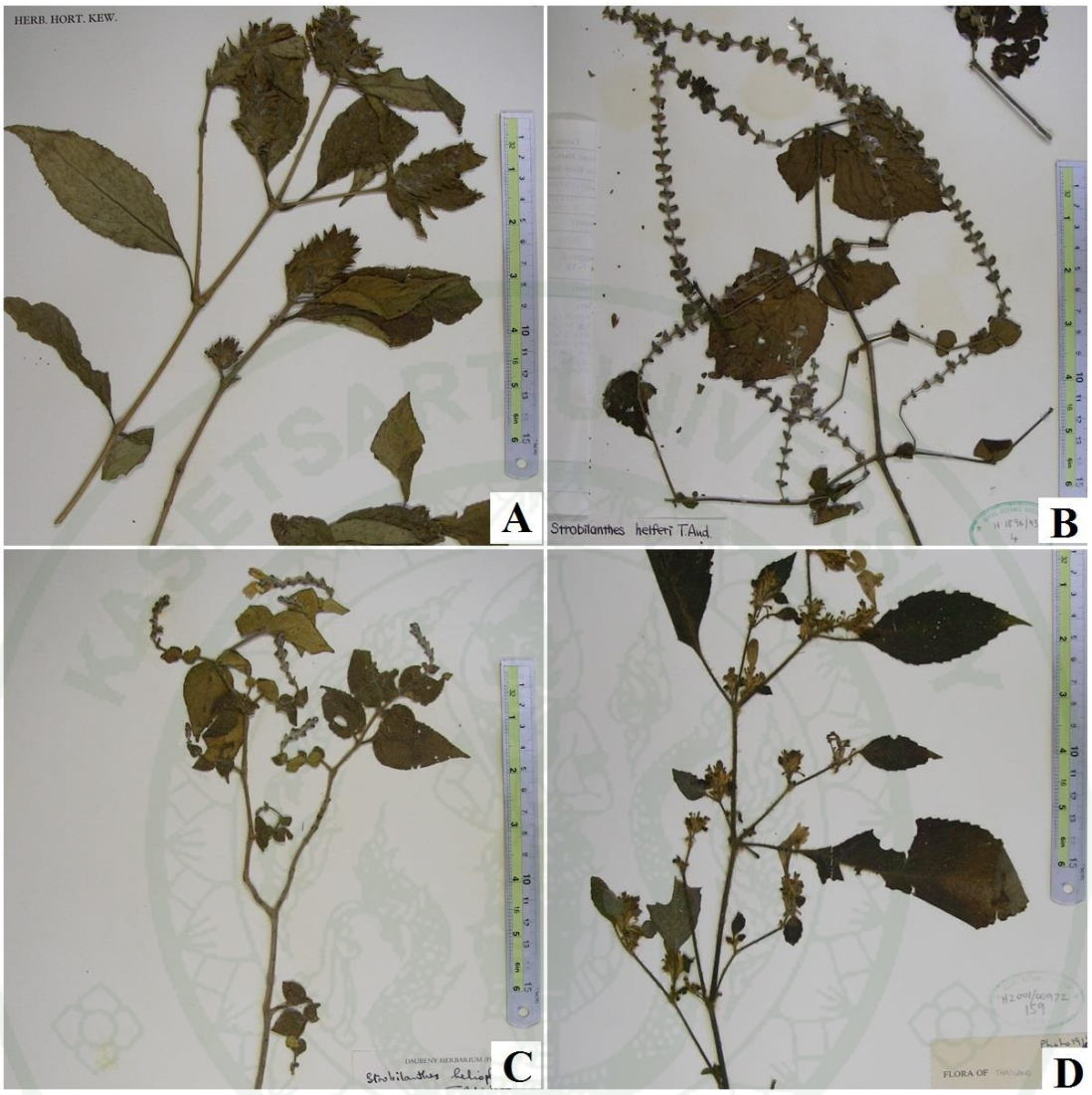

Appendix Figure 15 Plant specimens of Ruelliinae, Acanthaceae: A=*Strobilanthes glaucescens* Nees (from Chalaemphol no. 401); B= *S. helferi* T. Anderson (from Geesink, Hiepko and Phengklai T. 7626); C=*S. heliophila* J.R.I. Wood (from Kostermans no. 377); D=*S. Hossei* C.B. Clarke (from Goring no. 19)

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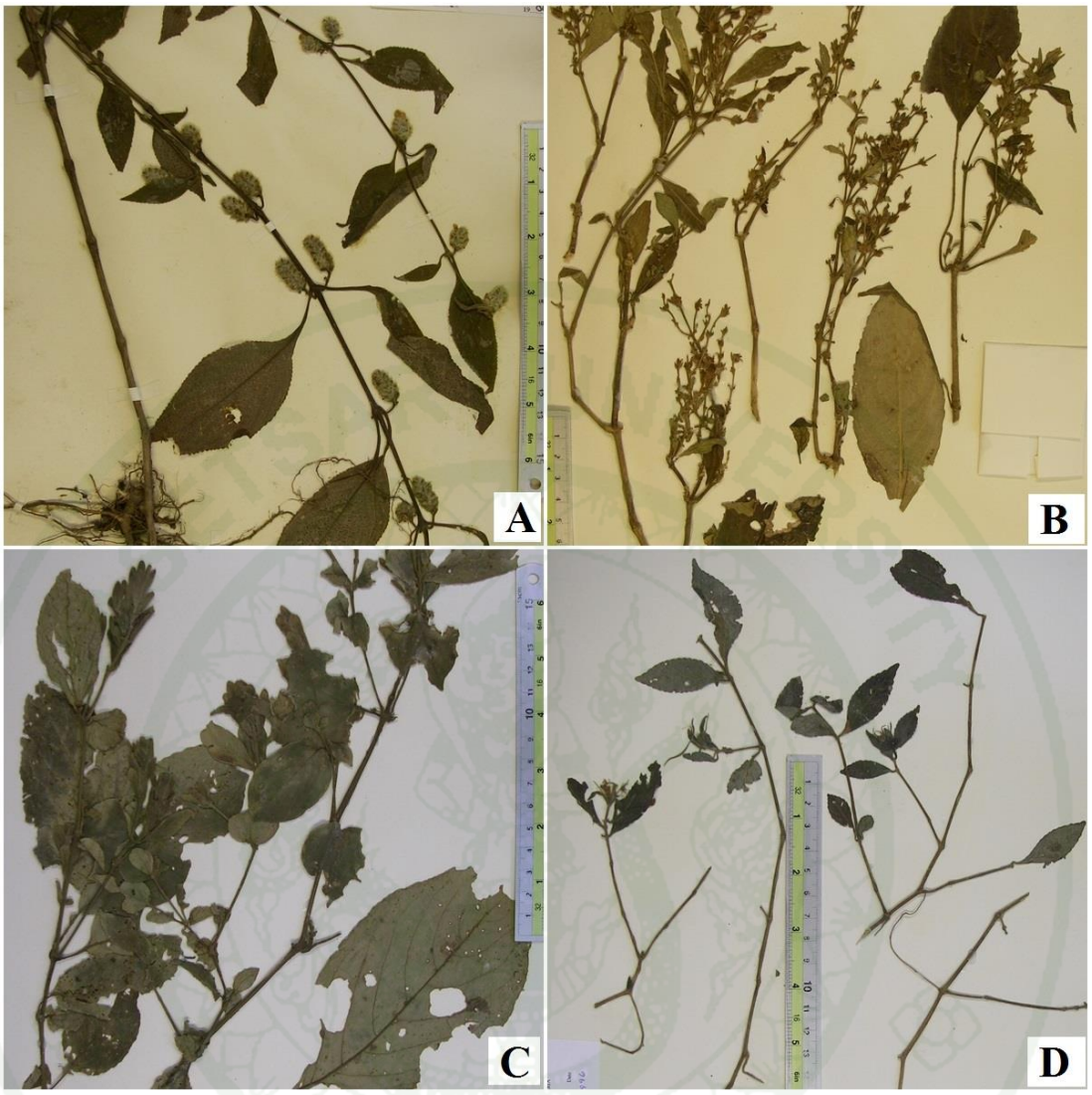

Appendix Figure 16 Plant specimens of Ruelliinae, Acanthaceae: A=*Strobilanthes imbricata* Nees (from Kerr no. 2237); B=*S. lanceifolia* T. Anderson (from Kerr no. 15229);
C=*S. maxwellii* J.R.I. Wood (from Shimizu *et al.* 26673);
D=*S. mochifera* Blume (from Kerr no. 9420)

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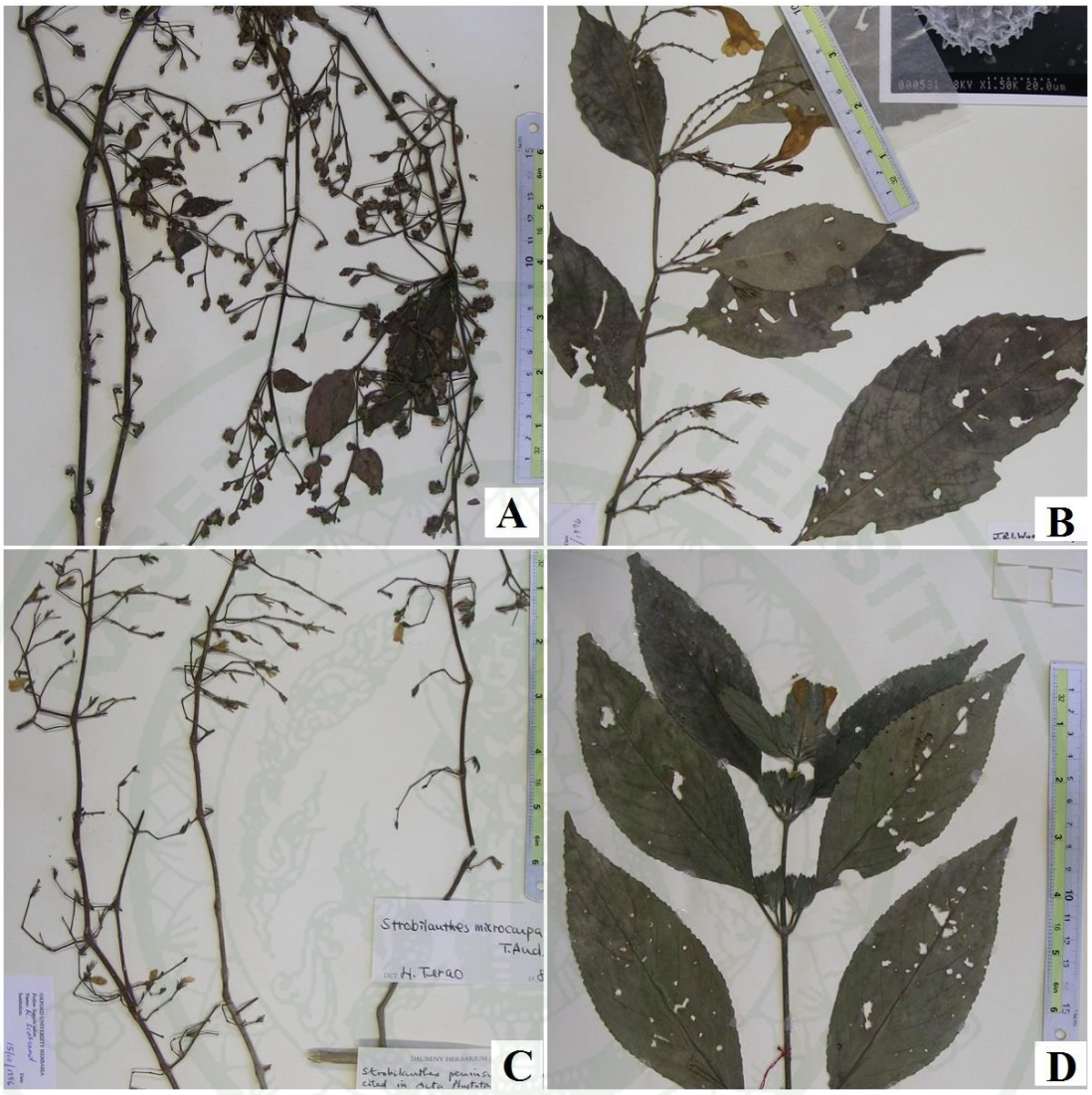

Appendix Figure 17 Plant specimens of Ruelliinae, Acanthaceae: A=*S. paniculata* T. Anderson (from Kerr no. 16236); B=*S. pateriformis* Lindau (from Hennipman no. 3610); C=*S. microcarpa* T. Anderson (from Put no. 2370); D=*S. quadrifaria* (Wall. ex Nees) Y.F. Deng (from Smitinand no. 1914)

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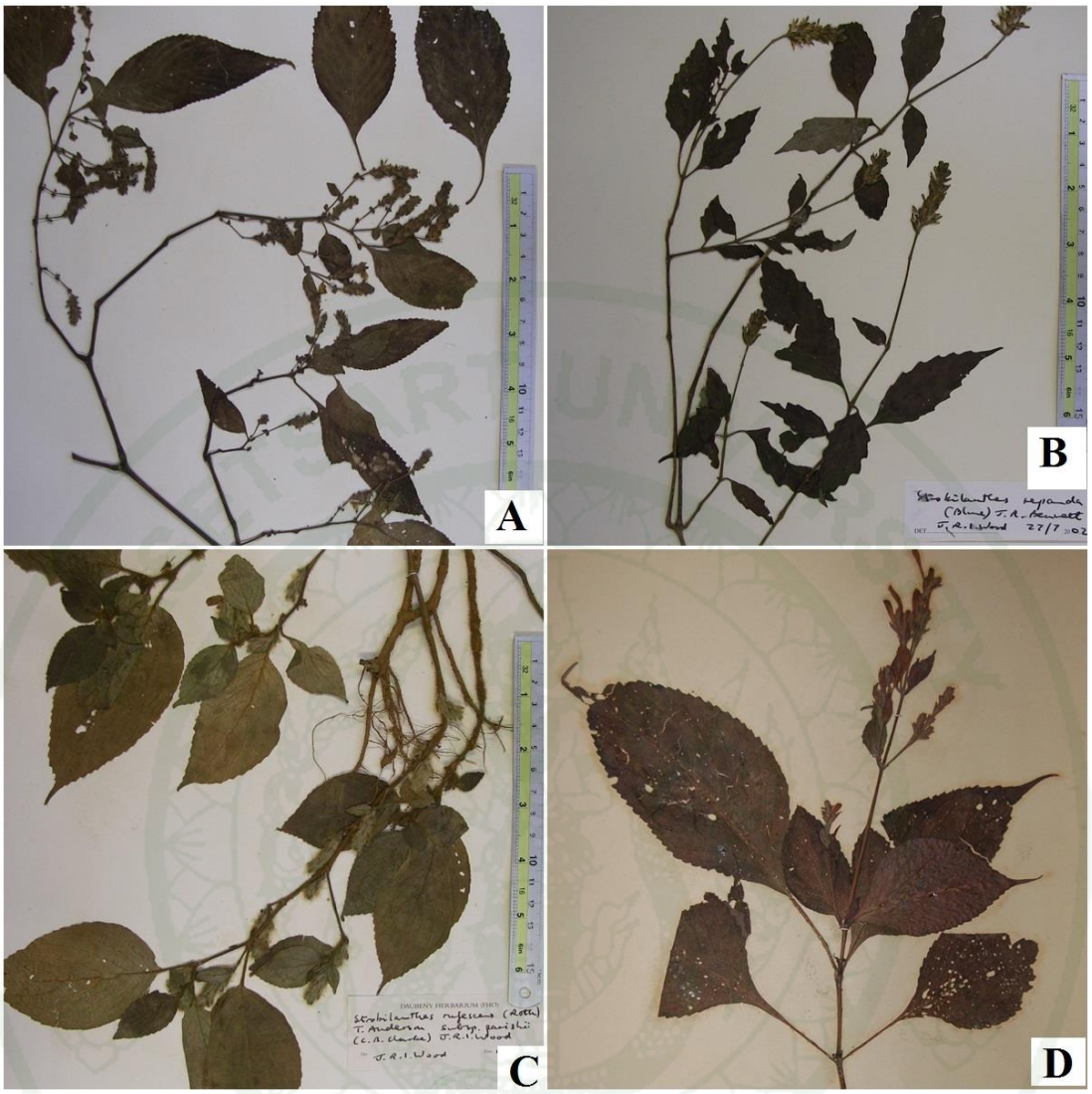

Appendix Figure 18 Plant specimens of Ruelliinae, Acanthaceae: A=*S. rivularis* J.R.I. Wood & J.R. Benn.(from Koyama, Terao and Wongprasert T. 32098); B=*S. repanda* (Blume) J.R. Bennett. (from Smitinand and Robbins no. 7890); C=*S. rufescens* (Roth) T. Anderson subsp. *parishii* (from Koyama, Terao and Wongprasert T. 33252); *D*=*S. serrata* J.B. Imlay (from Kerr no. 6587)

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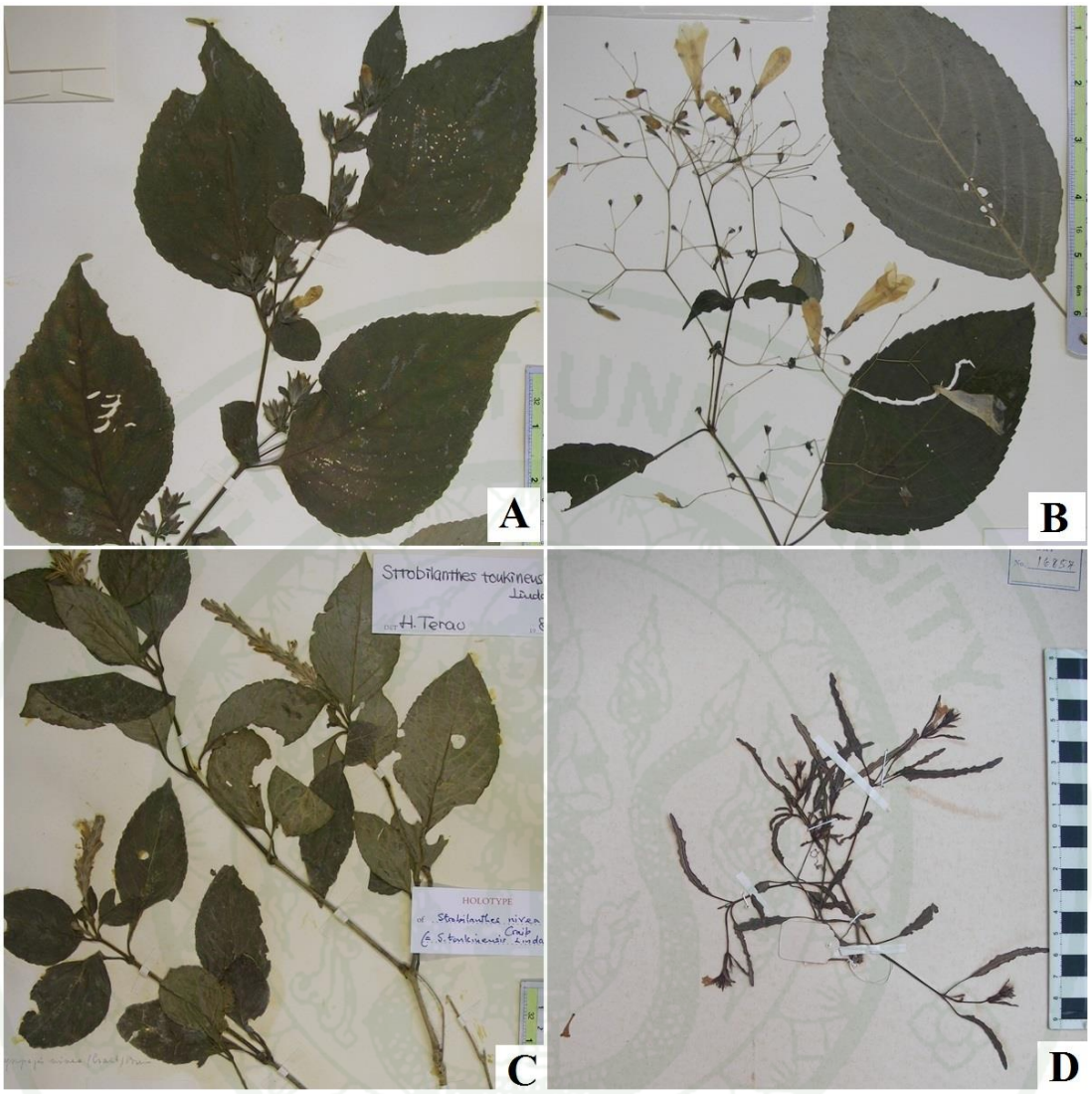

Appendix Figure 19 Plant specimens of Ruelliinae, Acanthaceae: A=*S. speciosa* Blume (from Kerr no. 489); B=*S. tenuiflora* J.R.I. Wood (from Garrett no. 488); C=*S. tonkinensis* Lindau (from Kerr no. 2442); D= *Hemigraphis repanda* (L.) Hallier f.(from Smitinand no. 4428), (the unplaced species)

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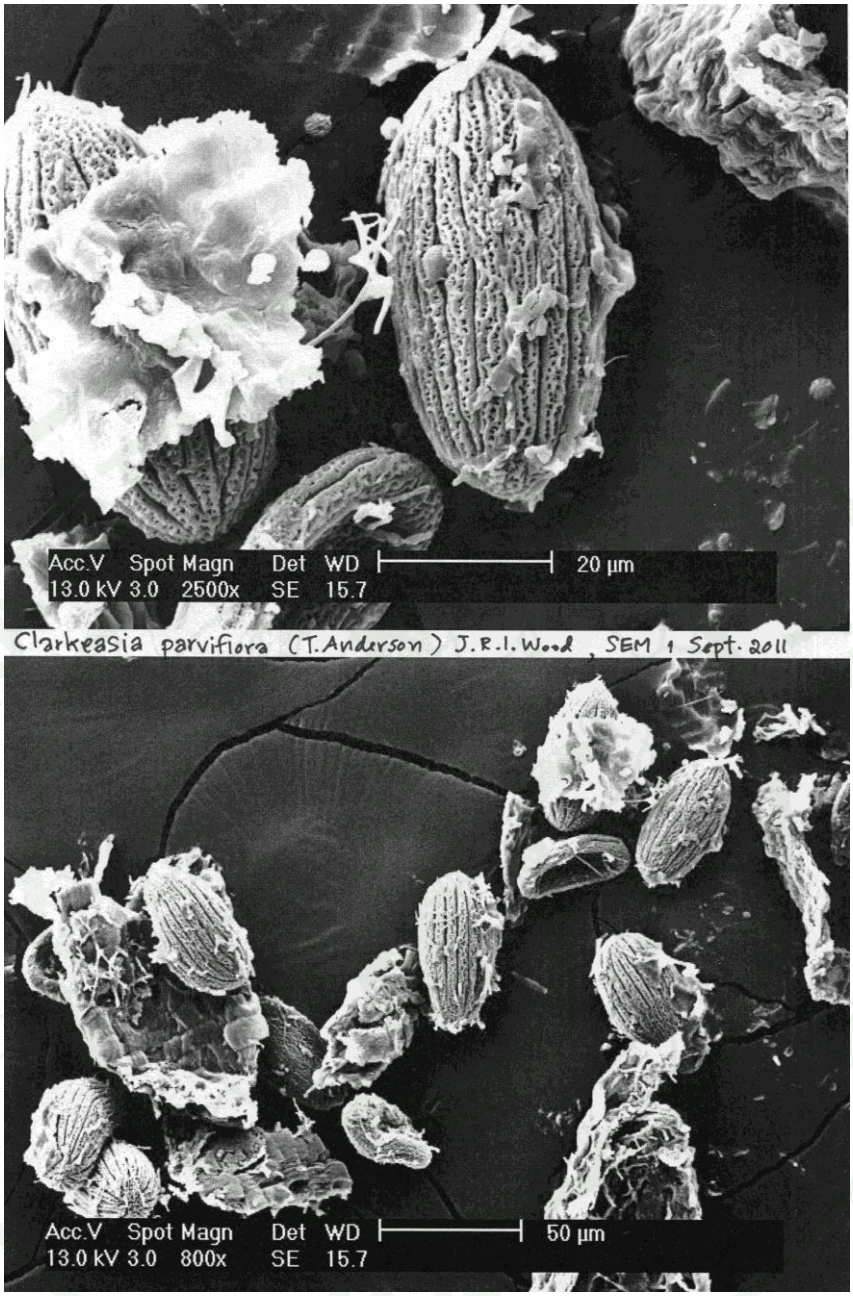

Appendix Figure 20 Pollen grains of *C. parviflora* (T. Anderson) J.R.I. Wood, tri-colporate, psudocolpate, reticulate tectum. Scale bars = 20 and 50 µm.

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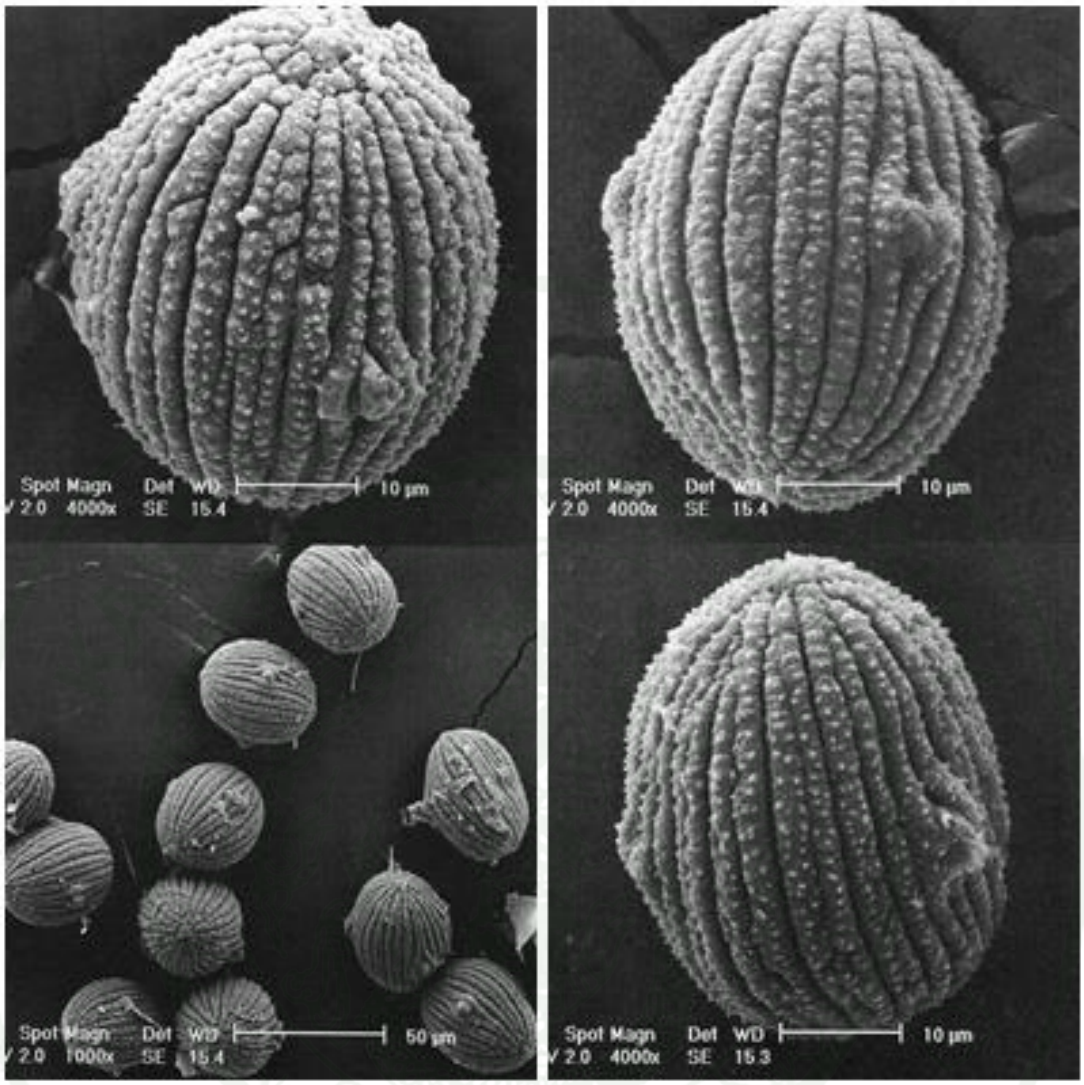

Appendix Figure 21 Pollen grains of *Dyschoriste erecta* (Burm. f.) Kuntze, Scale bars = 1

0 and 50 µm.

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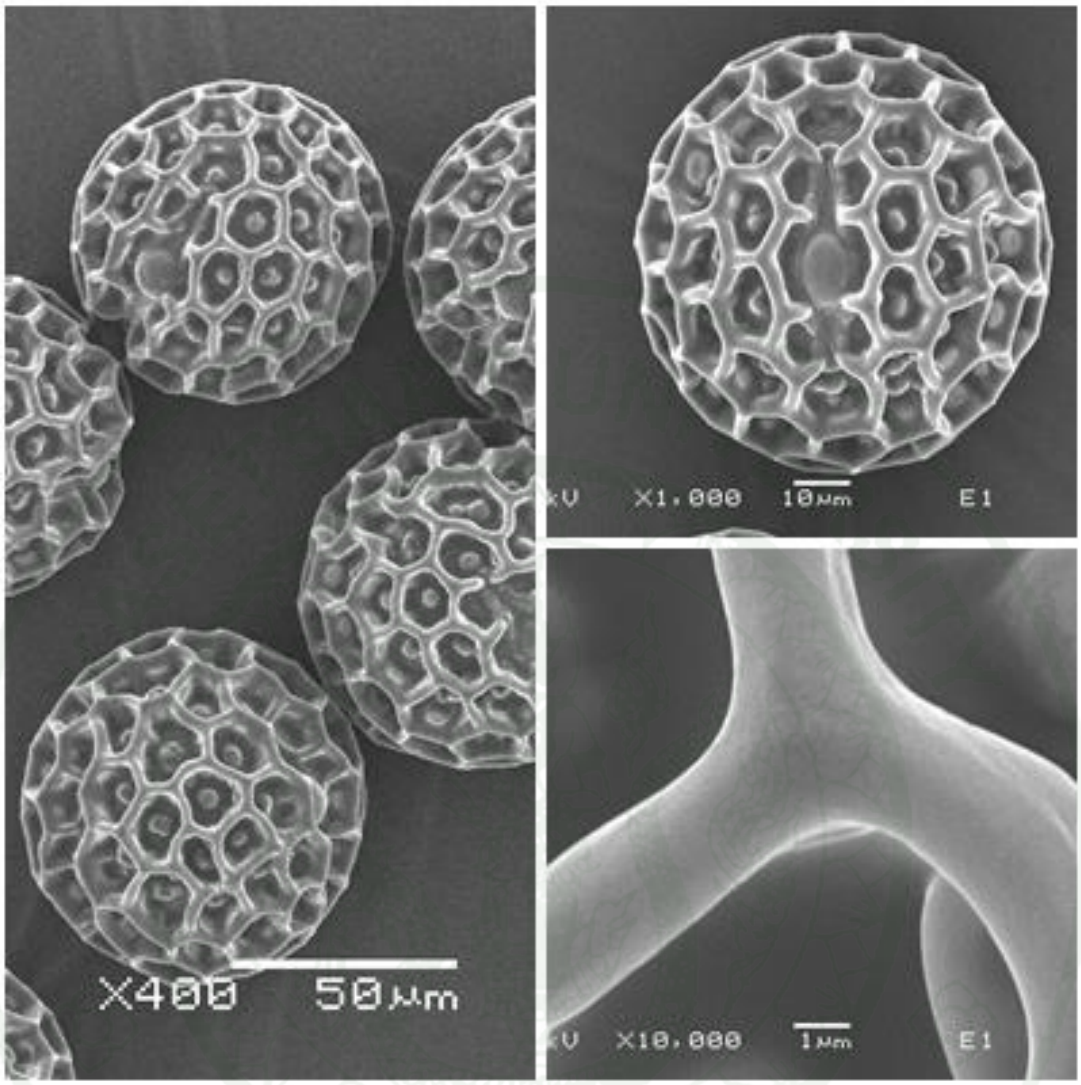

Appendix Figure 22 Pollen grains of *Eranthemum macrophyllum* Wall. ex Nees, tri-colporate, open reticulate tectum with granules of exine in the lumina. Scale bars = 1, 20, 50 µm.

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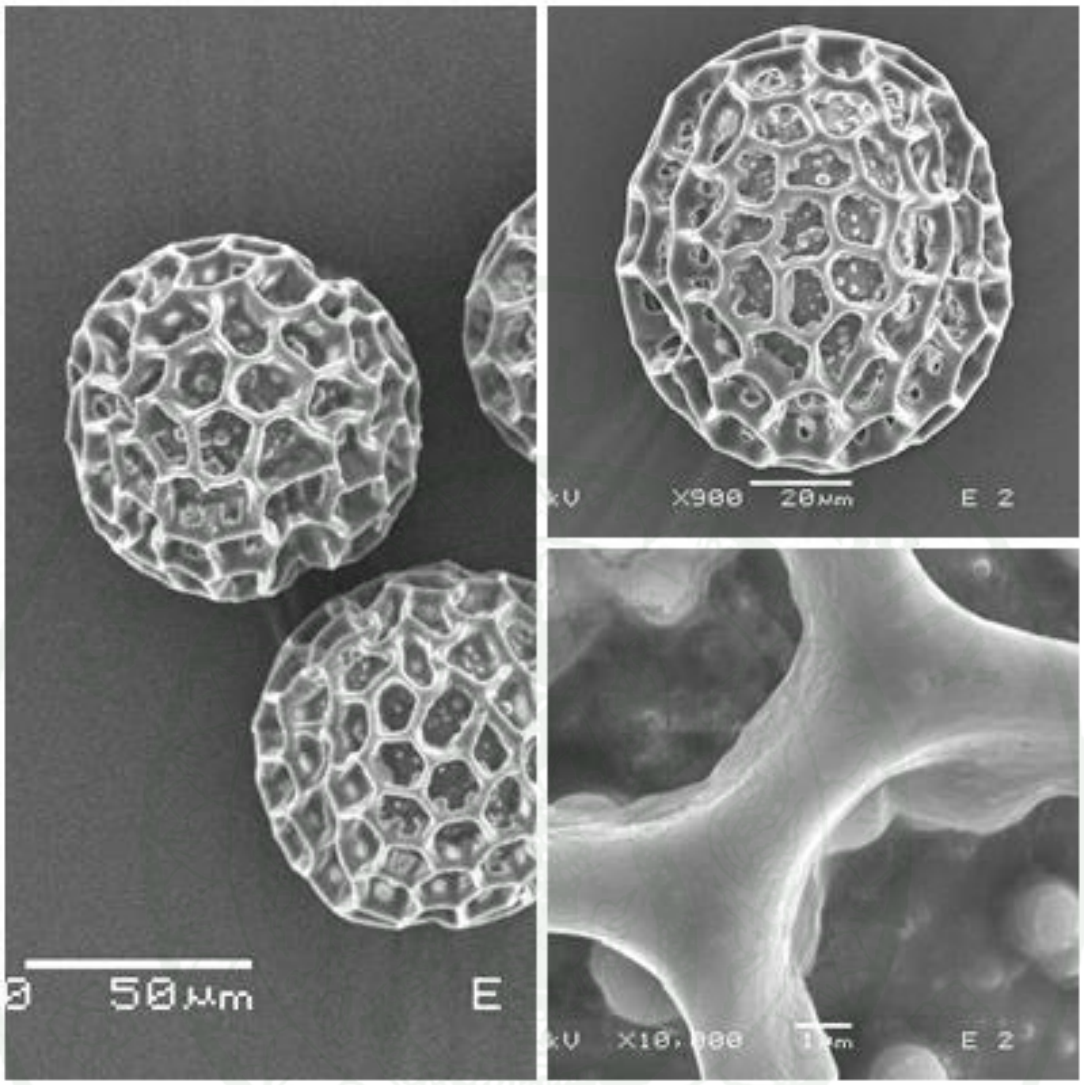

Appendix Figure 23 Pollen grains of *Eranthemum suffruticosum* Colebr. ex Roxb., open retinaculate tectum, tri-colporate, with granules of exine in lumina. Scale bars = 1, 20, 50 µm.

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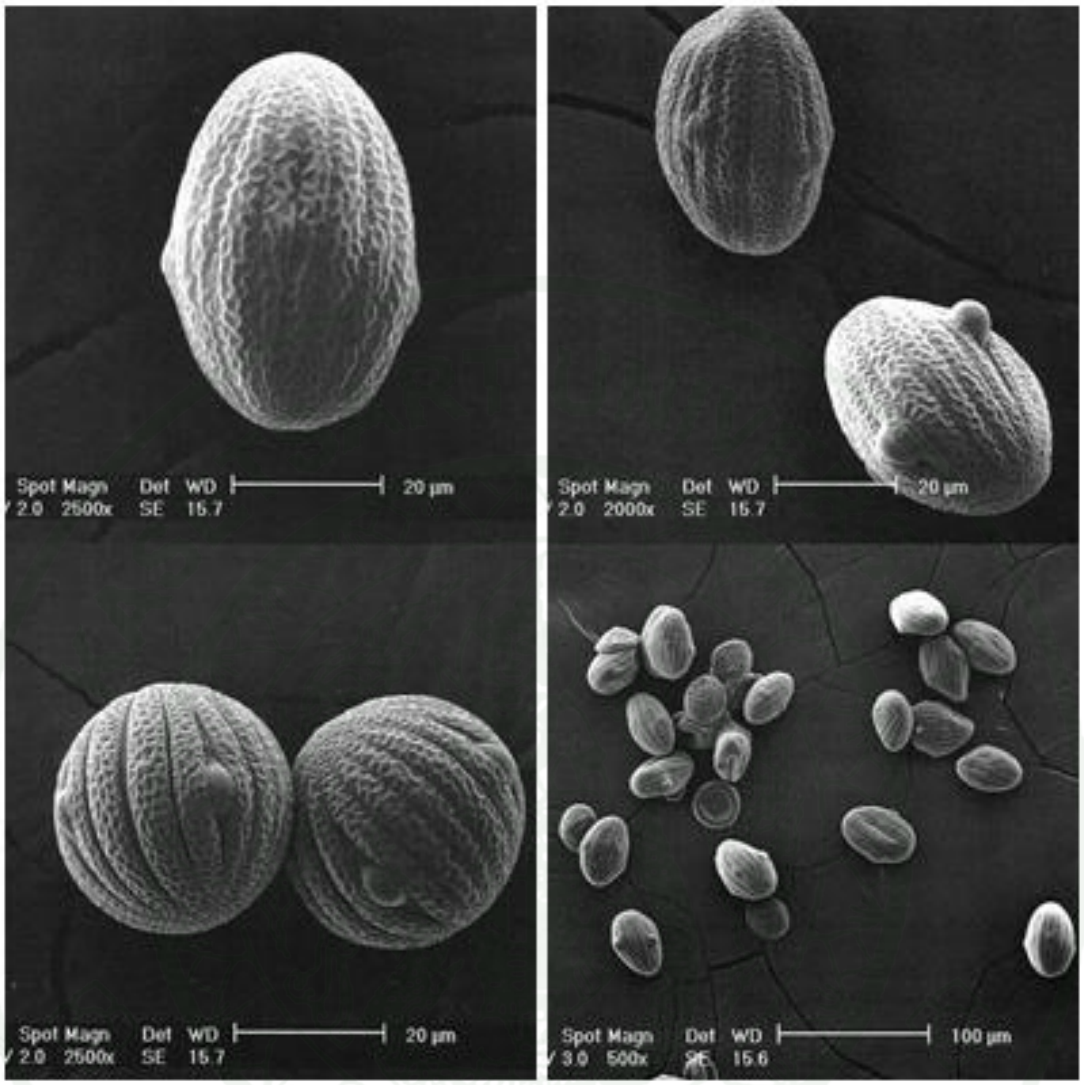

Appendix Figure 24 Pollen grains of *Hygrophila ringens* (L.) R. Br. ex Spreng. var. *ringens*. Scale bars = 20, 100 µm.

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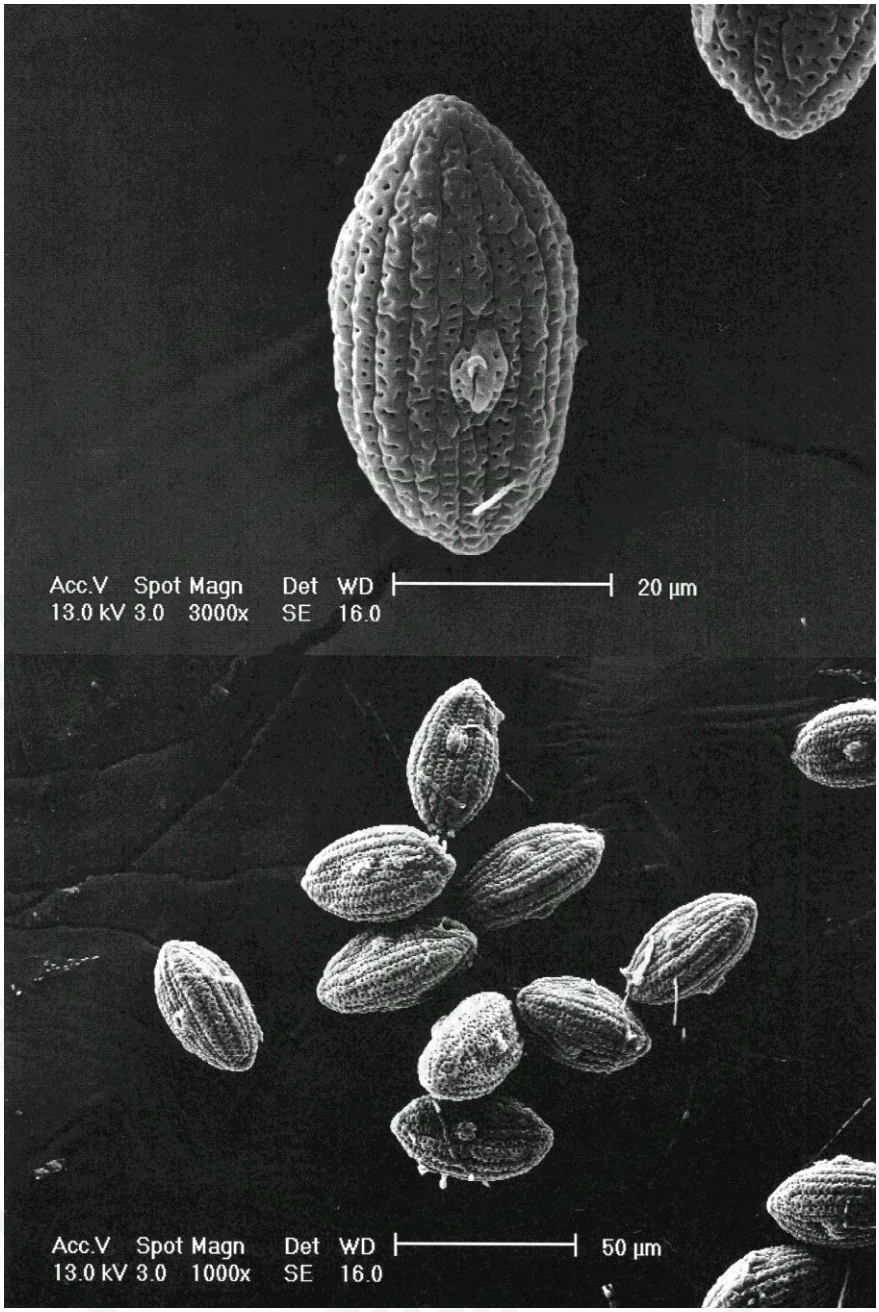

Appendix Figure 25 Pollen grains of *Phaulopsis dorsiflora* (Retz.) Santapau. Scale bars = 20, 50 µm.

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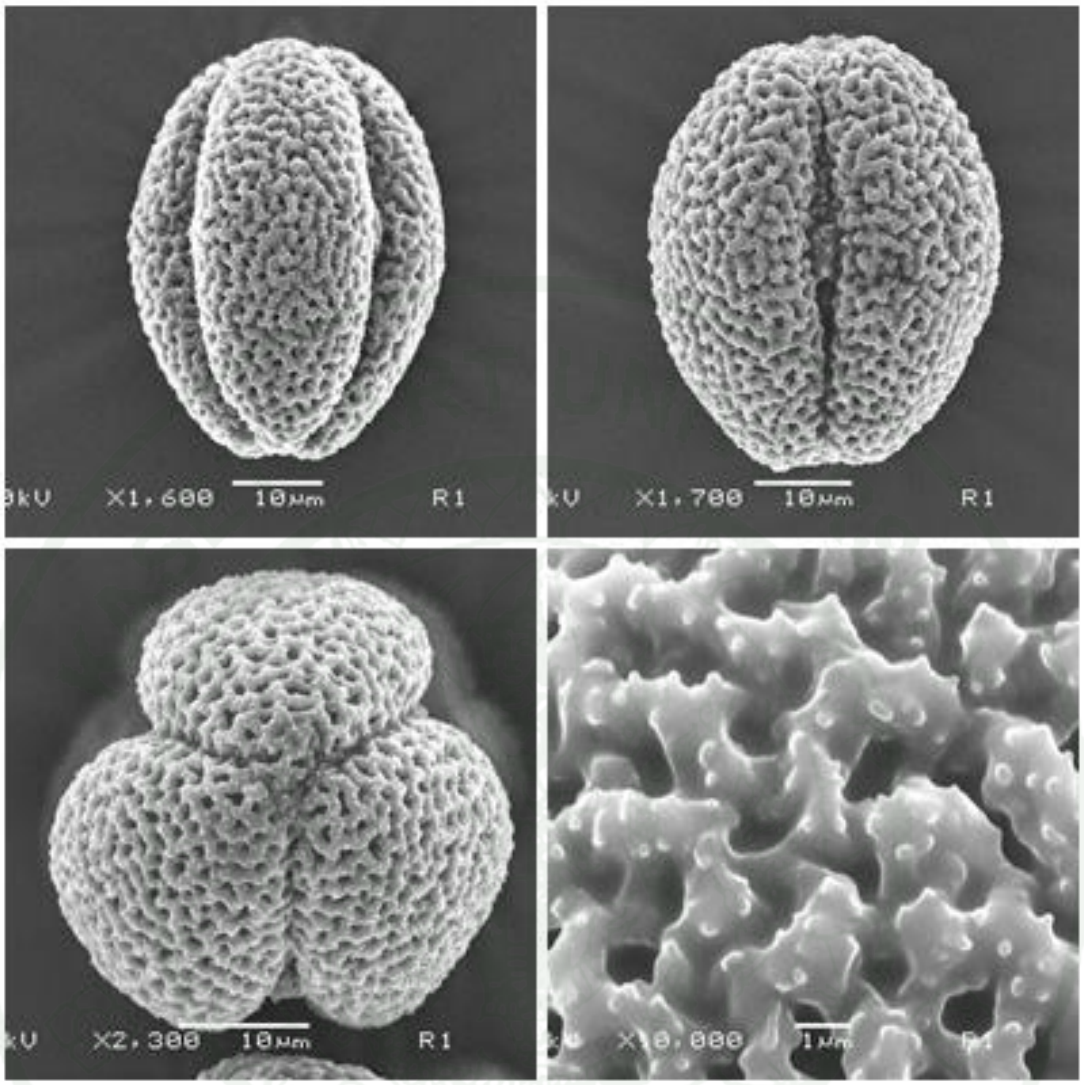

Appendix Figure 26 Pollen grains of *Ruellia blechum* L. tri-aperturate with apertures jointed at the poles (syncopate).
Scale bars= 1, 10 µm.

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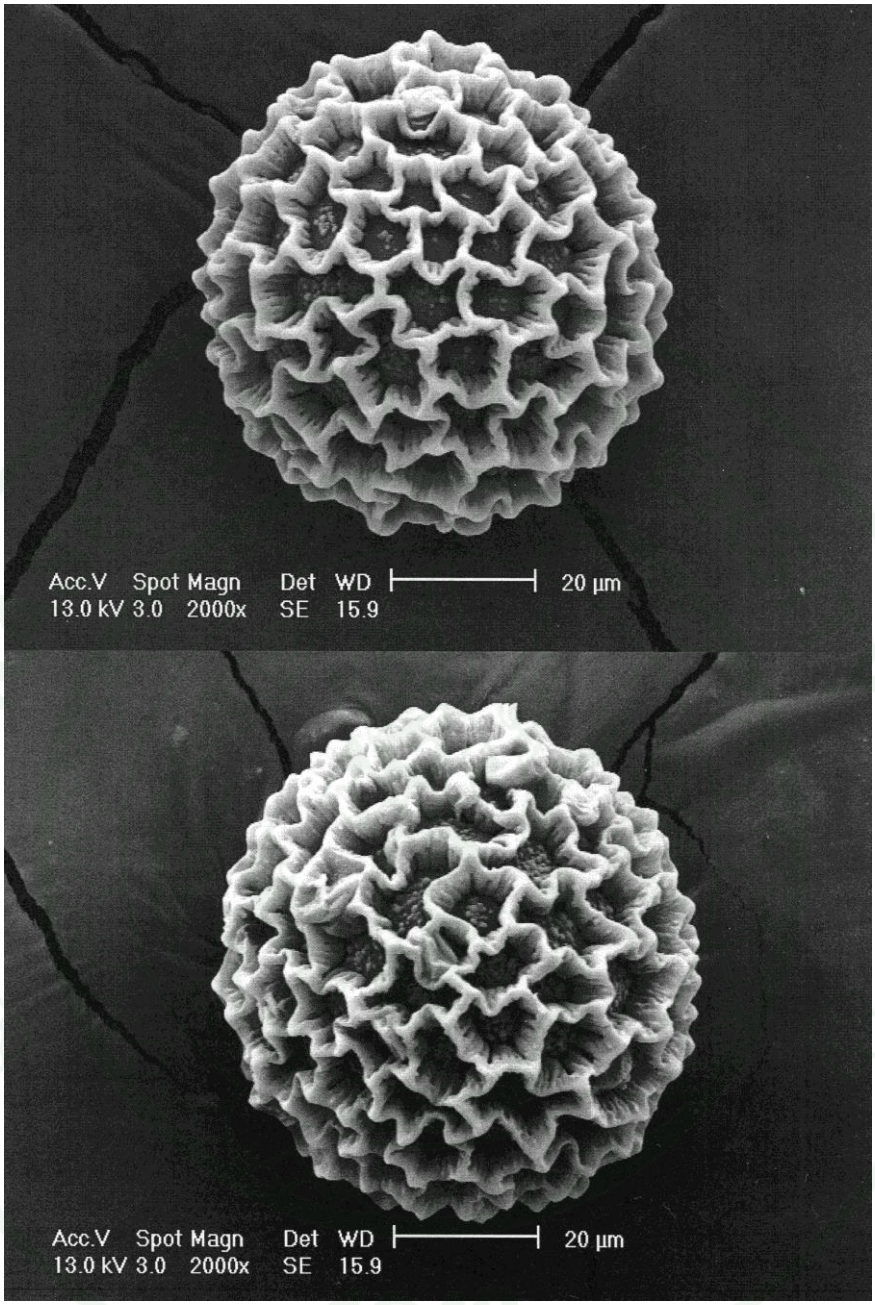

Appendix Figure 27 Pollen grains of *Ruellia kerrii* Craib, triporate, less open reticulate tectum, with occasional small granules of exine in the lumina. Scale bars=20 µm.

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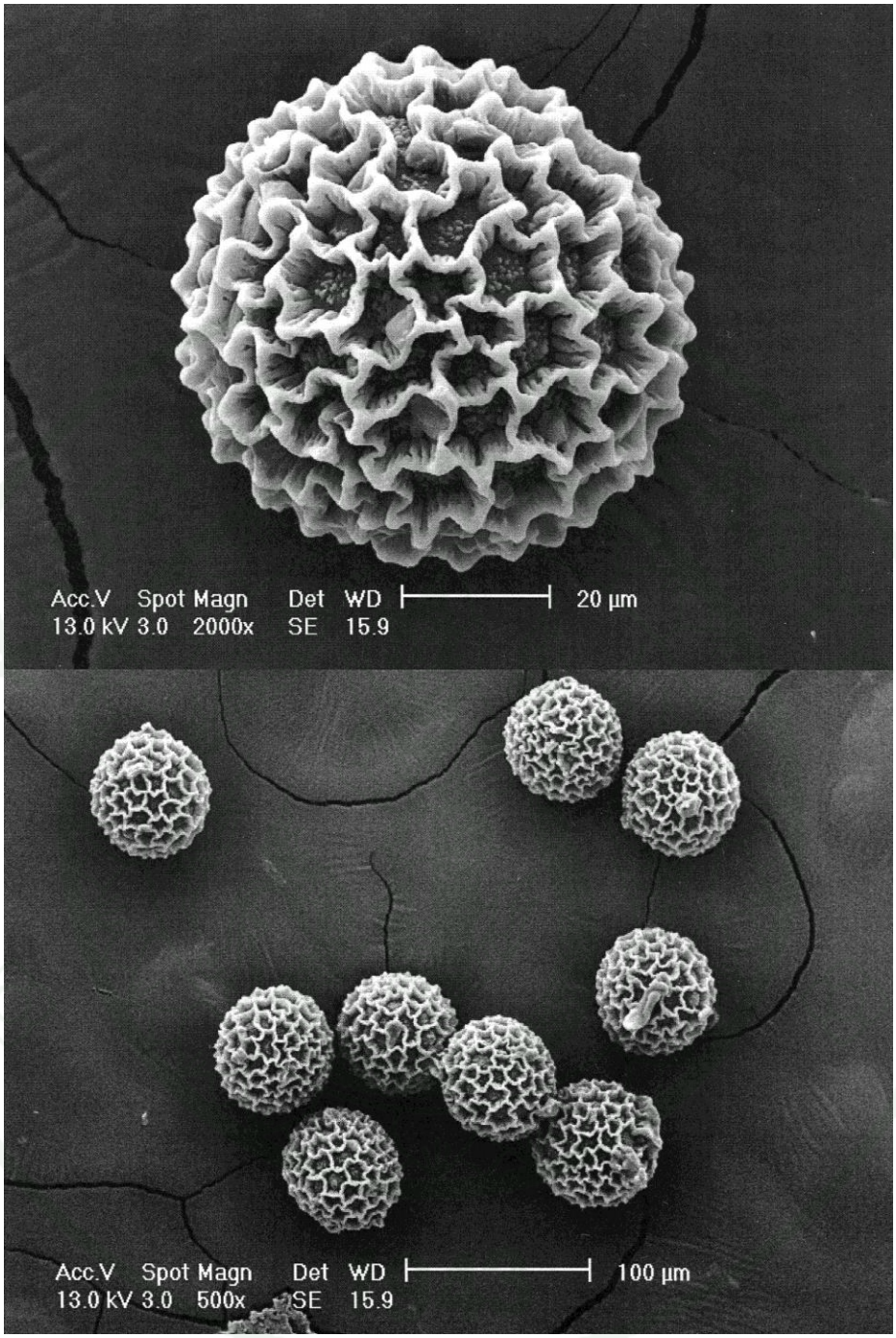

Appendix Figure 28 Pollen grains of *Ruellia tuberosa* L., triporate, less open reticulate tectum, with occasional small granules of exine in the lumina. Scale bars= 20, 100 µm.

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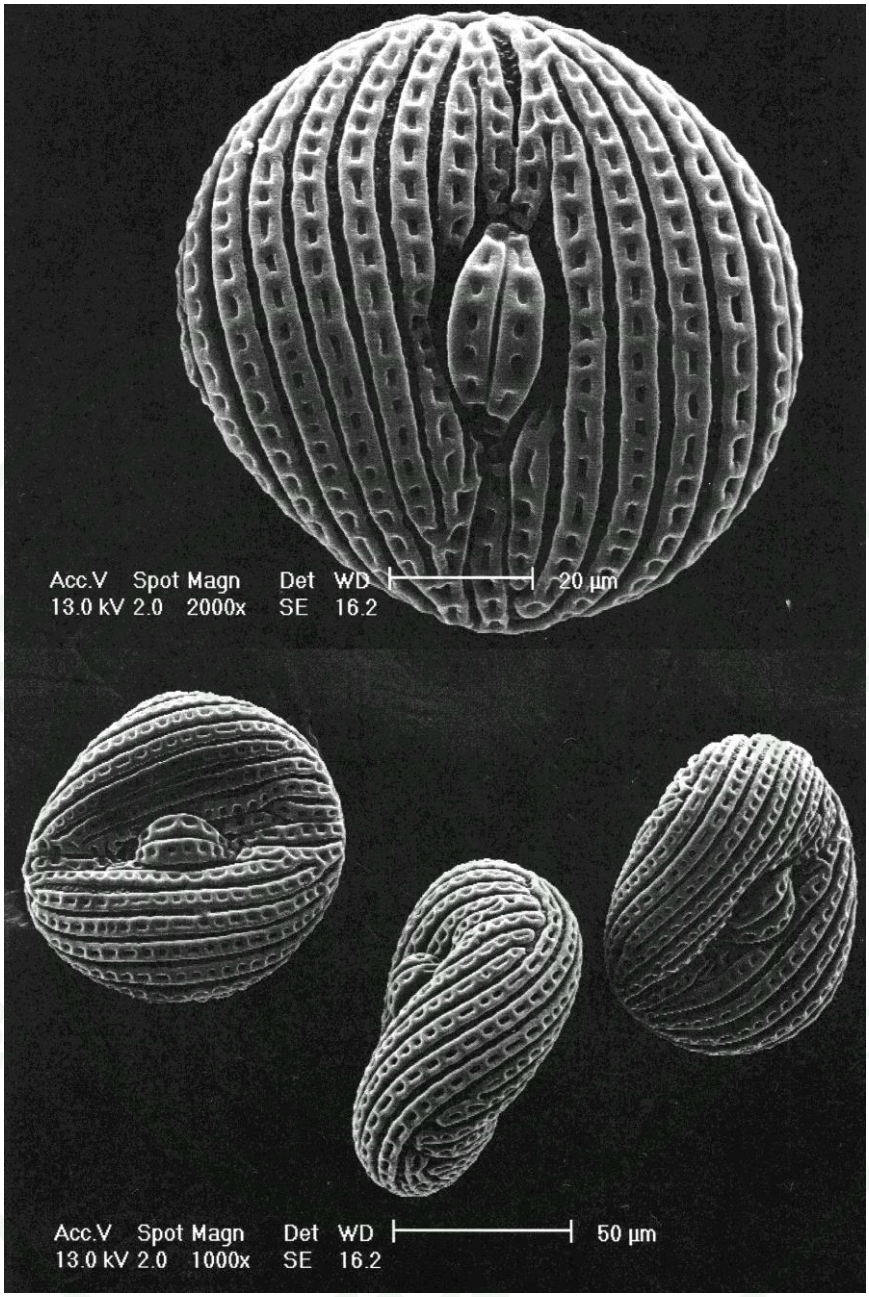

Appendix Figure 29 Pollen grains of *Sanchezia oblonga* Ruiz & Pav. showing two apertures and two raised areas of tectum associated with each aperture, bireticulate ribs. Scale bars= 20, 50 µm.

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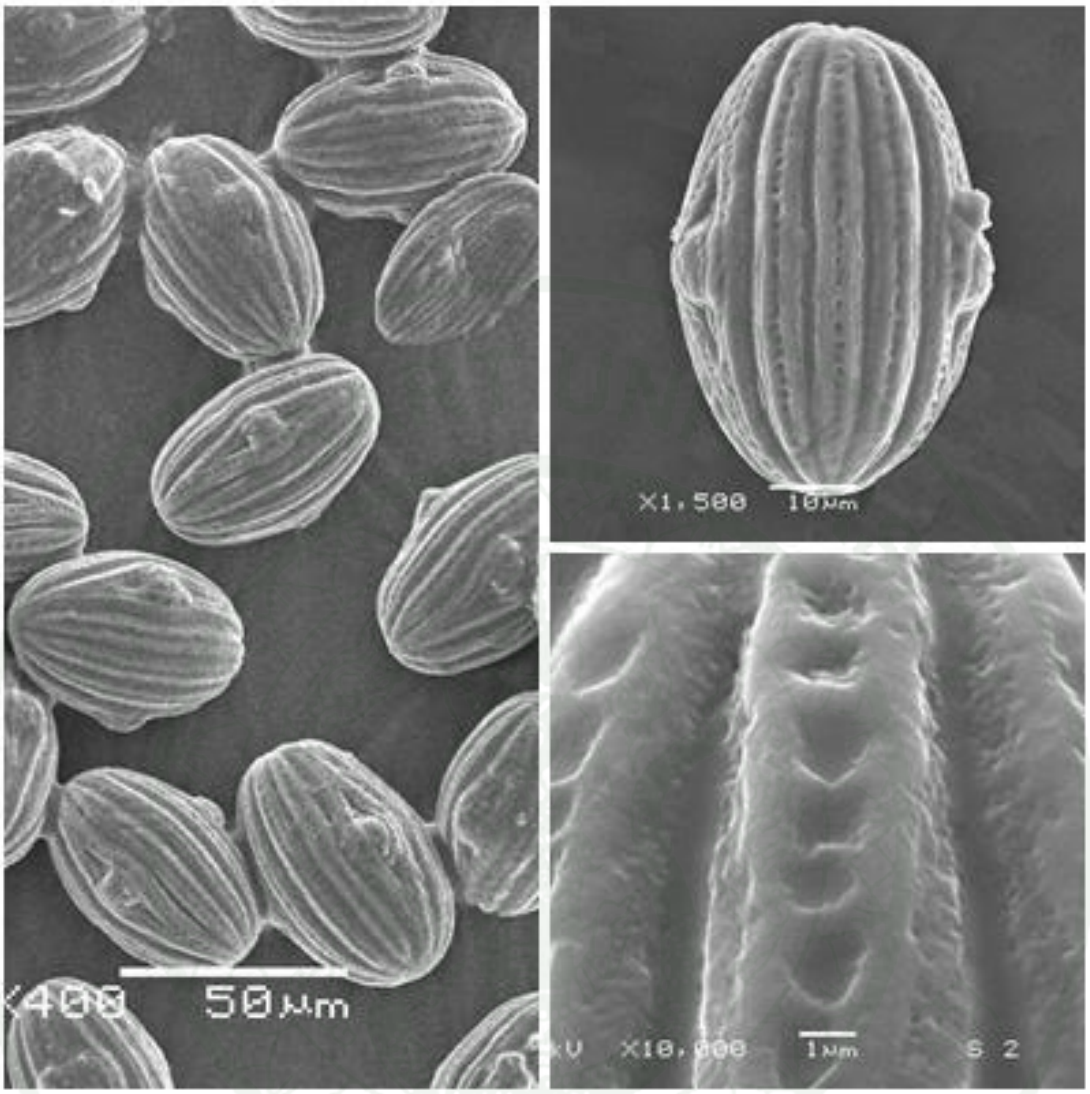

Appendix Figure 30 Pollen grains of *S. abbreviata* Y.F. Deng & J.R.I. Wood, with pseudocolpate, bireticulate. Scale bars= 1, 10, 50 µm.

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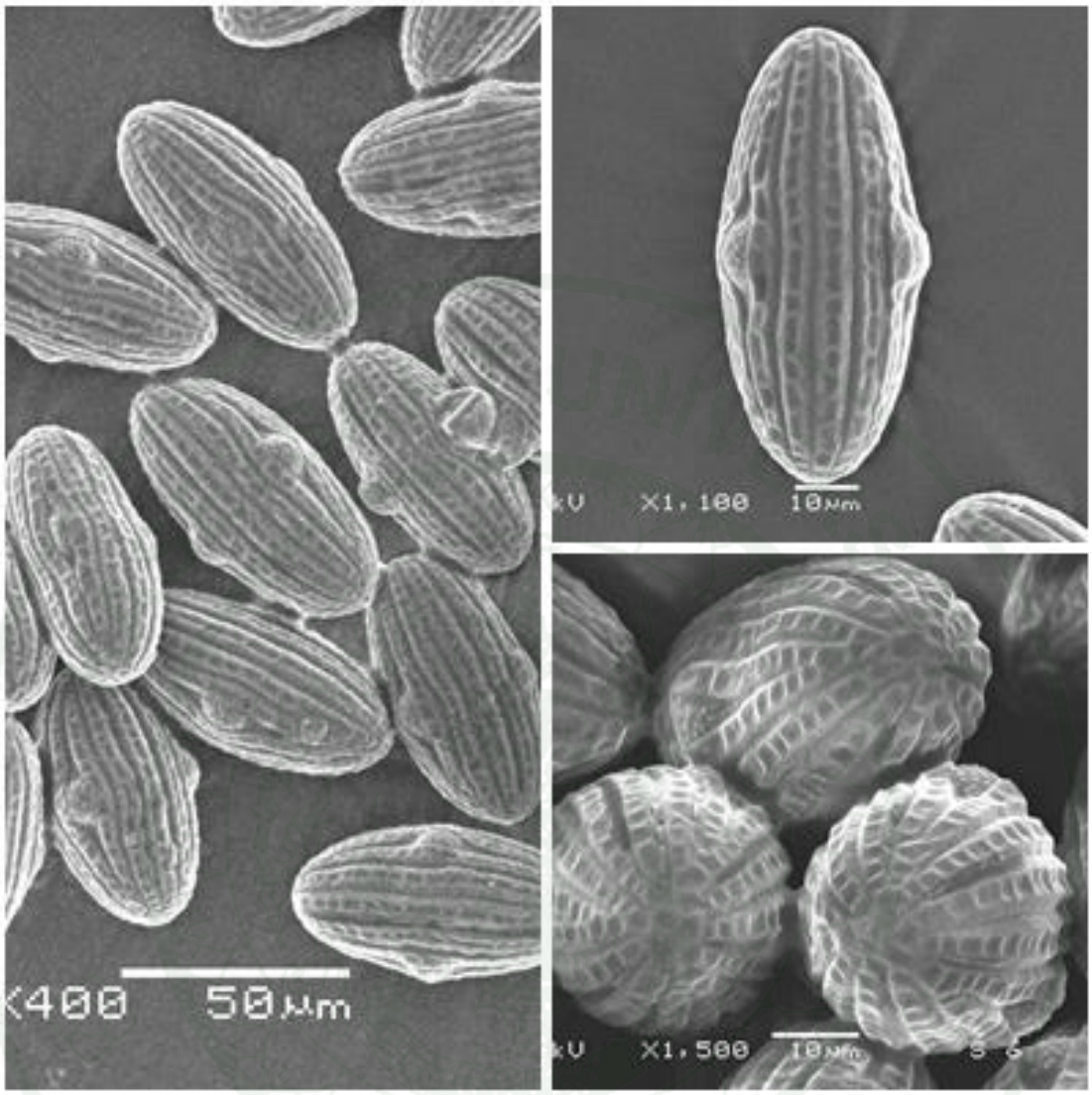

Appendix Figure 31 Pollen grains of *S. auriculata* Nees var. *auriculata* with pseudocolpate, bi-reticulate with pseudocolpate, bireticulate . Scale bars= 1, 10, 50 µm.

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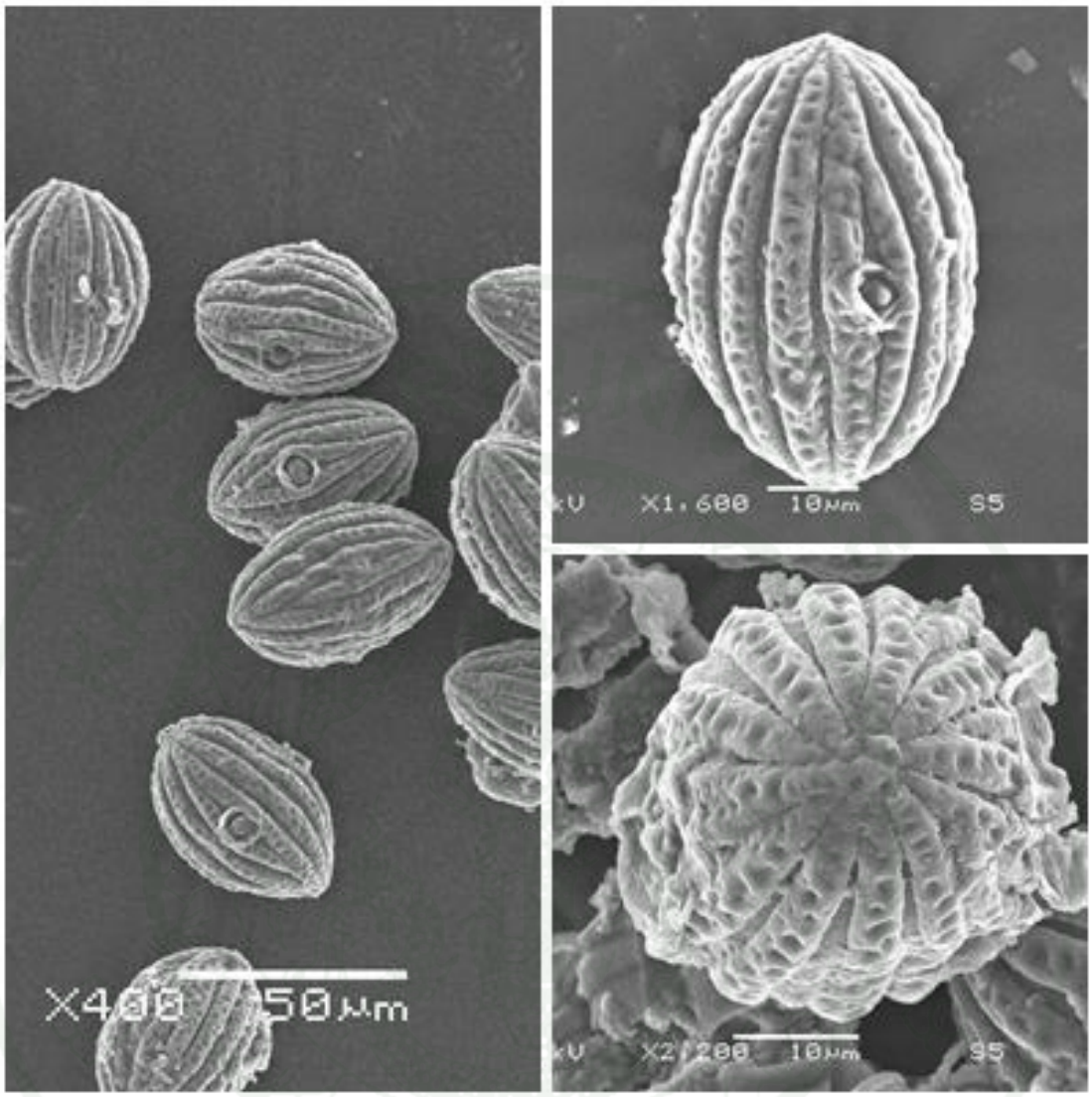

Appendix Figure 32 Pollen grains of *Strobilanthes chinensis* (Nees) J.R.I. Wood & Y.F. Deng; with pseudocolpate, reticulate.
Scale bars= 1, 10, 50 µm.

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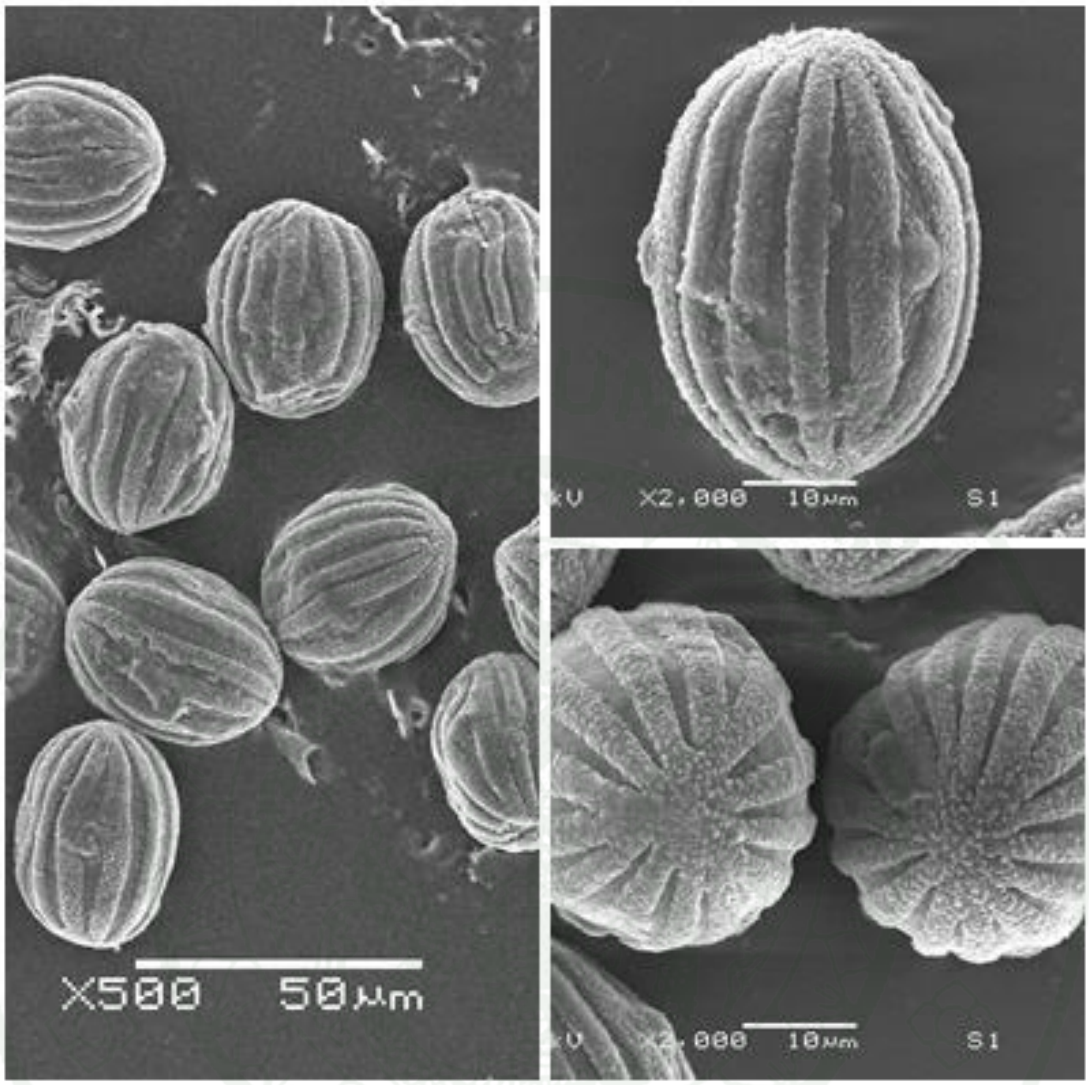

Appendix Figure 33 Pollen grains of *Strobilanthes corrugata* J.B. Imlay, pseudocolpate, ribs with scrabate tectum. Scale bars= 1, 10, 50 µm.

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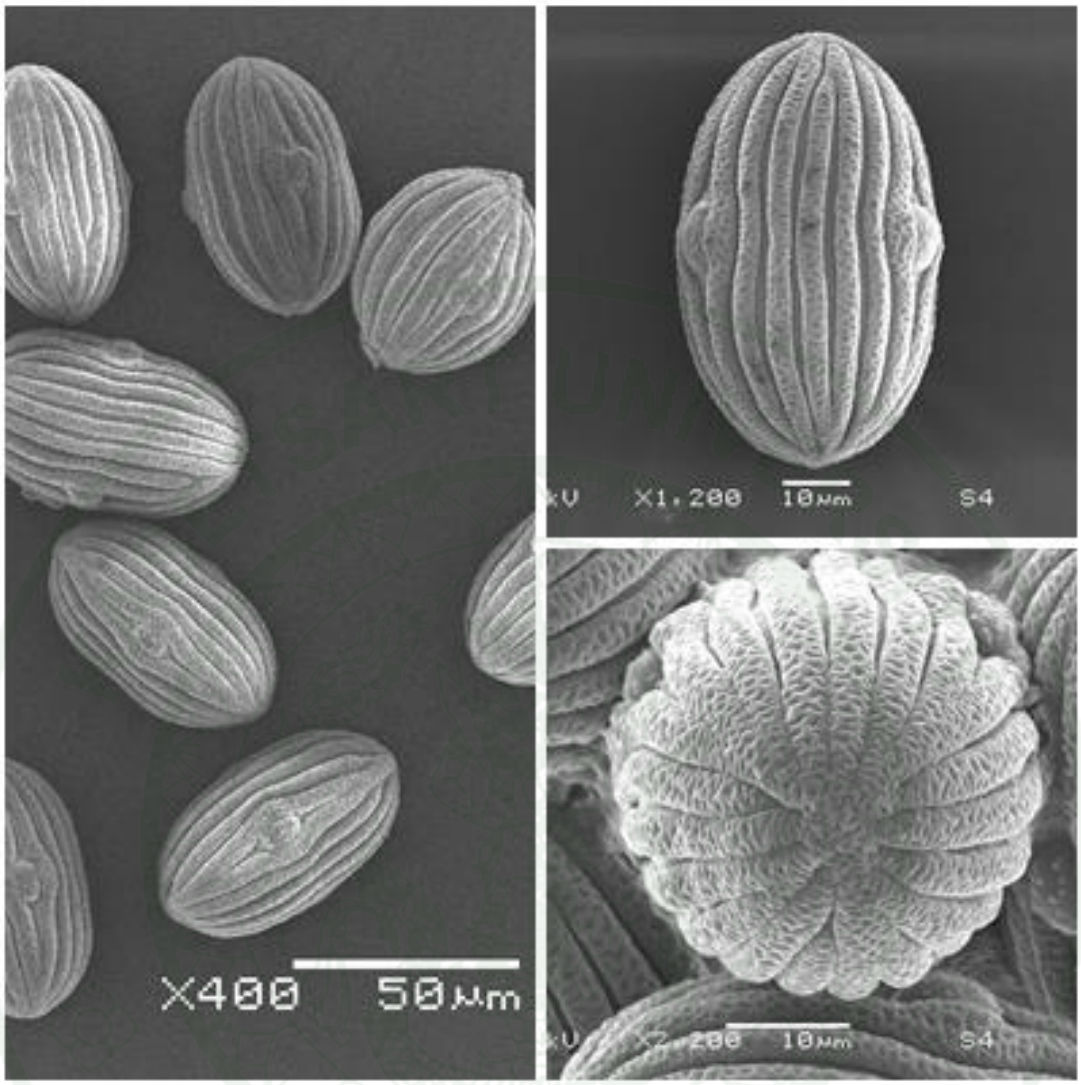

Appendix Figure 34 Pollen grains of *S. quadrifaria* (Wall. ex Nees) Y.F. Deng. with pseudocolpate, reticulate ribs. Scale bars= 1, 10, 50 µm.

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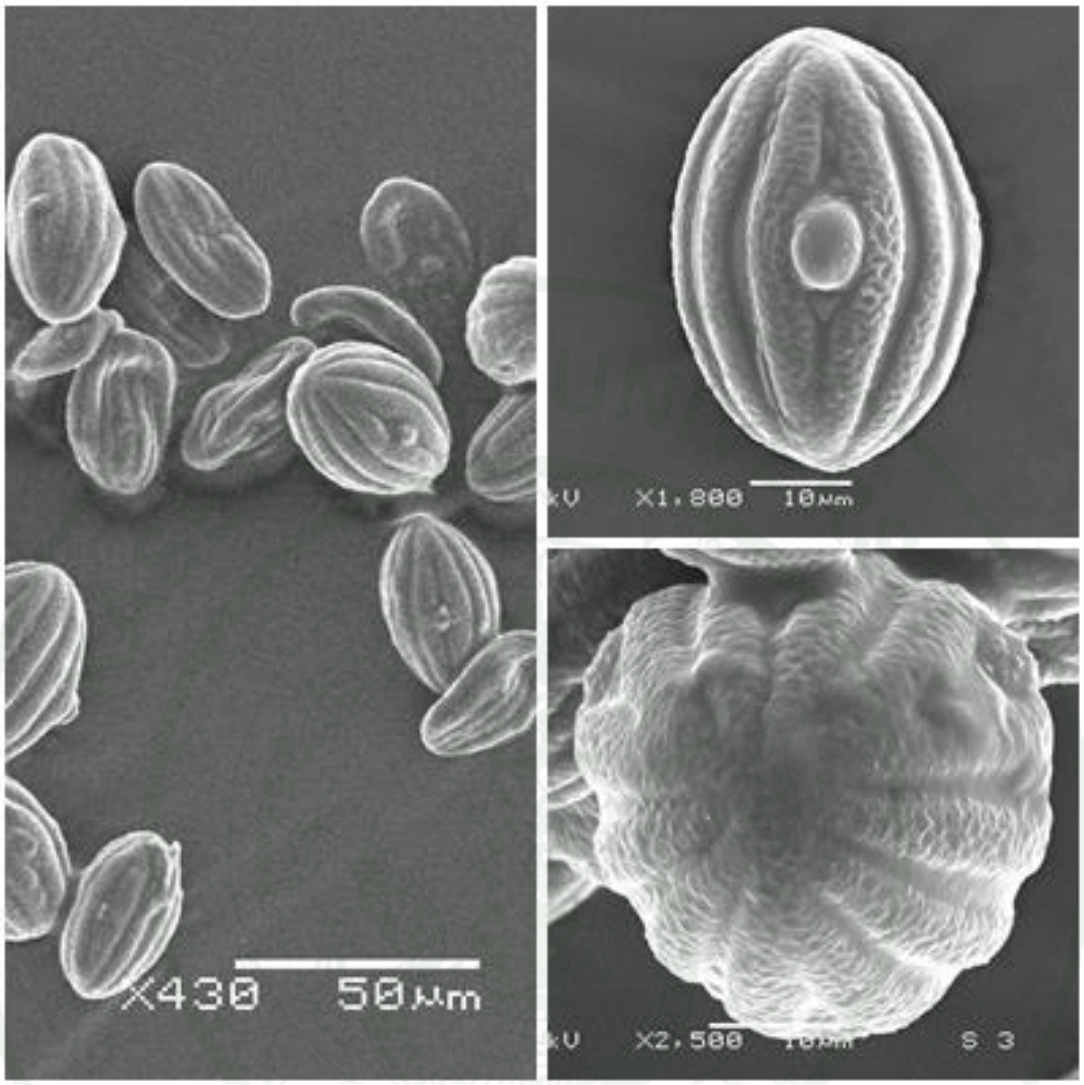

Appendix Figure 35 Pollen grains of *S. schomburgkii* (Craib) J.R.I. Wood**,** with pseudocolpate, bireticulate, Scale bars= 1, 10, 50 µm.

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