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Computer-generated keys to the flora of Egypt. 7. The Acanthaceae *s.l.*

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Abstract A conventional key and its tabular version to the 36 species from 21 genera of the Acanthaceae *s.l.* in Egypt are provided. The key is based on 48 characters of vegetative and floral morphology recorded comparatively for the species. The key-generating package of computer programs DELTA was used to construct the keys and to provide detailed and coded descriptions of the species in terms of the recorded characters. The set of 36 species includes the ten species growing spontaneously in the country and 26 species grown as garden ornamentals. The key and detailed descriptions provided are a marked improvement over previous keys and descriptions of the wild species and an entirely novel means of identifying the cultivated ones. The present study is the first application in Egypt of the DELTA suite of programs to generate identification keys to cultivated plants. All 48 characters are easily observable so that the key is equally easy to use in laboratories and on excursions by amateur and professional botanists.

Introduction

The Acanthaceae Juss. ex Bercht. & J. Presl are a relatively large family comprising ca. 3900 species accommodated in 200–205 genera (Bergianska, 2015). It is currently placed in order Lamiales close to the Bignoniaceae (APG III, 2009). The plants are predominantly herbs or small shrubs; erect, procumbent or climbers are distributed mainly in tropical regions, especially in south and southeast Asia, Africa, Brazil and Central America; some species (*Acanthus ilicifolius*, *A. albus*, *Avicennia* spp.) form thick inter-tidal forests in the mangrove habitat (Debnath et al., 2013). The leaves are simple (rarely pinnatisect), opposite, decussate, exstipulate, and frequently with epidermal or hypodermal calcium carbonate cystoliths and/or calcium oxalate crystals. The stem is usually articulated and slightly swollen at the nodes, and the young twigs are tetragonal. Inflorescence is highly variable from solitary axillary flowers to monochasial and dichasial cymes, terminal racemes and aggregated verticillasters in leaf axils. Flowers are hermaphrodite, hypogynous, pentamerous (rarely tetramerous), pedicelled or sessile and vary from nearly regular to strongly zygomorphic depending mostly on the configuration of the corolla; resupination is frequent in species of some

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genera. The flower may be subtended by one or two bracts with or without a pair of bracteoles; internodes between flowering nodes may be shorter than bracts so that bracts at successive nodes become overlapped. Sepals 5, free, united, or only the anterior pair is united, equal or unequal (reduced to a short rim with truncate apex or with 8–12 min teeth in *Thunbergia*), usually hairy and rich in cystoliths. Petals 5 (or 4), consistently united, with equal or nearly equal lobes or strongly 2-lipped; in resupinated flowers with 2-lipped corollas the anterior (lower) lip is 2-lobed while the posterior (upper) is 3-lobed; in non-resupinated flowers with 2-lipped corollas the posterior (upper) lip is 2-lobed and may be vaulted or deflexed upwards while the anterior (lower) lip is 3-lobed and variegated or not. The corolla tube may be as long as the calyx or much longer, straight or strongly curved, and of the same colour as its free lobes or of a different colour than the lobes. Fertile stamens 2 or 4 (didynamous), epipetalous, exserted or included in the corolla tube, with or without a posterior staminode; staminal filaments are much longer than anthers or as long as or shorter than anthers, with short glandular and eglandular hairs or glabrous; Anthers 1- or 2-lobed, dehisce through a longitudinal slit (rarely poricidal), sometimes with a dense tuft of unicellular eglandular or multicellular glandular hairs along the dehiscence slit. The two lobes of the same anther may be equal or distinctly unequal, parallel or divergent, adhered closely to each other or separated by a well-developed connective, and or both may possess apical or basal appendages of various forms. The gynoecium is invariably 2-carpelled; the ovary is 2-loculed, with 1-many anatropous ovules per locule on axile placenta, and occupies a median position on a well-developed nectar disc; the style is frequently longer than the corolla tube; the stigma consists of two equal or unequal globular or cylindrical lobes which vary from straight to curved or coiled. Fruit a septicidal 2-valved capsule (indehiscent 1-seeded drupe in *Avicennia*) with an explosive mechanism of dehiscence which aids in seed dispersal; each seed is subtended by the lignified remnants of the funicle usually known as 'jaculators' or 'retinacula' (absent in *Thunbergia* and *Avicennia*), which seem to assist the explosive dehiscence of the fruit. For a more detailed description of the family see Watson and Dallwitz (1992 onwards; version 11th May 2015 and Bergianska (2015).

Both relationships to other families and circumscription of the family were controversial for several decades. Lindau (1895) presented a comprehensive classification of the Acanthaceae in which he divided the family into four subfamilies: Nelsonioideae, Mendoncioideae, Thunbergioideae and Acanthoideae and placed the genus *Thomandersia* Baill. in the Acanthoideae-Asystasieae. *Thomandersia* was later isolated by Sreemadhaven (1975, 1977) into the new monogeneric family Thomandersiaceae on grounds of leaf architecture and some morphological features of the anthers. Recognition of the new family was further supported by the phylogenetic studies by Wortley et al. (2005a, 2005b, 2007).

The genus *Avicennia*, with its ten species of trees inhabiting the mangrove habitat in the inter-tidal zones in most of the tropical and sub-tropical parts of the world, was placed by different authors in various families including the Verbenaceae (*e.g.* Bentham and Hooker, 1876), Santalaceae (Van Tieghem, 1898), Dipterocarpaceae (Moldenke, 1960), Celastraceae (Dahlgren, 1975), as well as in a separate family Avicenniaceae (*e.g.* Cantino, 1992). Wagstaff and Olmstead (1997) and Oxelman et al. (1999) maintained that the Avicenniaceae show closer relationships to the Pedaliaceae or Acanthaceae than to the Verbenaceae. More recent phylogenetic analyses by Schwarzbach and McDade (2002) and Das et al. (2015) consistently placed *Avicennia* as sister to the Acanthaceae-Thunbergioideae or near the base of the Acanthaceae, and this concept is adopted in the present study.

According to Boulos (2002), the Acanthaceae *sensu stricto* are represented in the spontaneous flora of Egypt by ten species belonging to six genera. With the addition of *Avicennia marina*, representatives of the Acanthaceae *sensu lato* in Egypt become 11 species belonging to seven genera. The ten species recorded by Boulos (2002) include *Blepharis attenuata* Napper, which was described from Sinai. However, *B. attenuata* was omitted from the present study because all *Blepharis* specimens collected by us and by several other research teams from Sinai (including the type locality of *B. attenuata*) matched perfectly with the scores of specimens of *Blepharis edulis* (Forssk.) Pers. kept in the two major herbaria in Egypt at the Botany Department, Faculty of science, Cairo University (CAI) and the herbarium of the Flora and Phytotaxonomy Researches Department, Horticulture Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza (CAIM); acronyms are according to Holmgren et al. (1990).

In addition to the ten spontaneous species recoded by Boulos (2002), numerous species of the Acanthaceae are grown in Egypt as garden ornamentals in private and public gardens and nurseries. So far all available keys to the Acanthaceae in Egypt are concerned with only the wild species. Such keys are manually constructed and leave much to be desired. Furthermore, the numerous garden ornamentals are as yet without any identification keys. In addition to their aesthetic and commercial values, some of these garden ornamentals are of immense medicinal and pharmaceutical importance worldwide and their accurate identification can be vitally critical (*e.g.* Chauhan and Dixit, 2010; Brinda et al., 2013; Mahboubi et al., 2013; Behbahani, 2014; Chaudhary et al., 2014). Clearly, representatives of the Acanthaceae in Egypt, whether wild or cultivated, are in urgent need of such conventional (*i.e.* printable) computer-generated keys in which the shortcomings of their manually constructed counterparts would be avoided. These keys should be beneficial to amateur and professional botanists and horticulturists.

Material and methods

The present study is based on herbarium and fresh specimens of 36 species belonging to 21 genera of the Acanthaceae *sensu lato* collected from the herbarium of Botany Department, Faculty of science, Cairo University (CAI) and the herbarium of the of Flora and Phytotaxonomy Researches Department, Horticulture Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza (CAIM) and various botanical and public gardens and nurseries. Fresh material of the more common taxa grown usually as garden ornamentals (*e.g. Adhatoda vasica*, *B. cristata*, *Ruellia simplex*) or growing spontaneously in desert valleys (*e.g. Blepharis edulis*) and in the inter-tidal zone (*Avicennia marina*) at Nabq (Gulf of Aqaba, S. Sinai) was collected for recording some of the characters which are relatively difficult to determine accurately in herbarium material (*e.g.* colour and configuration of the delicate corollas). Approximately 700 herbarium specimens of

Table 1 Unedited list of 48 characters used in the generation of a key to 36 wild and cultivated species of Acanthaceae in Egypt as produced by the key-generating package of programs DELTA.

#1. Plant/ 1. tree/ 2. herb or shrub/

#2. Plant/ 1. erect/ 2. climbing/ 3. prostrate/

#3. Pneumatophores/ 1. present/ 2. absent/

#4. Stem nodes/ 1. articulated/ 2. not articulated/

#5. Inflorescence/ 1. of solitary axillary flowers/ 2. spike or raceme/ 3. axillary dichasial cymes/ 4. unilateral cymes/

#6. Flowers/ 1. pedicelled/ 2. sessile/

#7. Bracts/ 1. linear-lanceolate/ 2. broadly ovate/

#8. Bract/ 1. blade and veins of the same colour/ 2. veins darker than blade/

#9. Bract margin/ 1. entire-obscurely dentate/ 2. laciniate-spiny/

#10. Bract apex/ 1. spiny/ 2. not spiny/

#11. Bracts of successive flowers/ 1. overlapping/ 2. not overlapping/

#12. Interpetiolar spines/ 1. present/ 2. absent/

#13. Leaves/ 1. simple/ 2. pinnatisect/

#14. Leaves/ 1. petiolate/ 2. sessile-subsessile/

#15. Leaf margin/ 1. spiny/ 2. dentate/ 3. entire/

#16. Leaf apex/ 1. acute/ 2. acuminate/

#17. Leaf petiole/ 1. winged/ 2. not winged/

#18. Base of leaf blade/ 1. truncate-cordate/ 2. rounded/ 3. cuneate-decurrent/

#19. Leaf primary veins/ 1. pinnate/ 2. palmate/

#20. Sepals/ 1. free/ 2. united/ 3. only anterior pair united/

#21. Sepals/ 1. equal/ 2. unequal/

#22. Sepal margin/ 1. spiny/ 2. entire and glabrous/ 3. entire and ciliate/

#23. Petal lobes/ 1. two/ 2. four/ 3. five/

#24. Petal lobes/ 1. equal/ 2. unequal/

#25. Petals/ 1. thick, leathery/ 2. thin, not leathery/

#26. Anterior corolla lobe/ 1. variegated/ 2. not variegated/

#27. Corolla tube and lobes/ 1. of the same colour/ 2. of different colours/

#28. Corolla lobes/ 1. white-pale or dark blue/ 2. pale yellow-orange/ 3. red/

#29. Corolla throat/ 1. darker than lobes/ 2. not darker than lobes/

#30. Corolla posterior lobe/ 1. vaulted/ 2. deflexed/

#31. Fertile stamens/ 1. two/ 2. four/

#32. Thick tuft of hairs along anther dehiscence slit/ 1. present/ 2. absent/

#33. Anthers/ 1. two-lobed/ 2. one-lobed/

#34. Appendage on base of one or both anther lobes/ 1. present/ 2. absent/

#35. Lateral extension of staminal filament/ 1. present/ 2. absent/

#36. Base of each staminal filament/ 1. sagittate/ 2. not sagittate/ ..... (Fig. 1)

#37. Staminal filaments/ 1. hairy/ 2. glabrous/

#38. Staminal filaments/ 1. as long as or shorter than anthers/ 2. much longer than anthers/

#39. Anthers/ 1. exserted/ 2. included/

#40. Glandular hairs on style/ 1. present/ 2. absent/

#41. Leaf/ 1. veins much lighter than blade/ 2. blade and veins homogeneously green/

#42. Fruit/ 1. drupe/ 2. septicidal capsule/ ..... (Figs. 3, 4)

#43. Fruit/ 1. globular/ 2. almond-shaped/ 3. elongate/ ..... (Figs. 2-4)

#44. Fruit beak/ 1. as long as fruit/ 2. small appendage or absent/ ..... (Figs. 2-4)

#45. Retinacula in fruit/ 1. present/ 2. absent/ ..... (Fig. 4 left)

#46. Average leaf blade length/ cm/

#47. Average width of leaf blade/ cm/

#48. Average blade length/width ratio/

the 36 species were screened and collection data of only some of them are given in Appendix A; voucher specimens of the fresh material are kept in the herbarium of the Department of Botany and Microbiology, Faculty of Science, Suez Canal University (El-Arish Campus).

Correct identification of the specimens used in the construction of identification keys is essential for accuracy of the results obtained from those keys. Therefore, the identity of the specimens available for the present study was verified by re-identifying them with the aid of the local flora (Boulos, 2002) and the floras of neighbouring countries *e.g.* Andrews, 1956; Feinbrun-Dothan, 1977, 1978) as well as the e-floras of other countries with a rich representation of the Acanthaceae such as the flora of Pakistan (flora of Pakistan@efloras.org) and the flora of China (flora of China@efloras.org). Numerous floras of various parts of the world and monographs of individual tribes and subtribes (Barker, 1986; DeFilipps, 1992; Balkwill, 1996; Daniel, 2004; Wasshausen and Wood, 2004; Wasshausen, 2007; Shendage and Yadav, 2010; Daniel and McDade, 2014; Felger et al., 2014), and genera (Manktelow, 1996) were also consulted for verifying the identity of taxa in the present sample. Matching with the innumerable images of herbarium and fresh specimens of acanthaceous taxa available on scores of websites was another means of scrutinizing and correcting the erroneous identities of some of the available specimens. Nomenclature of all taxa with full publication details is given in Appendix A, after being updated according to the two major nomenclatural sources (The Plant List, 2013) and the Missouri Botanical Gardens Information System (2015, continued).

A set of 48 morphological characters have been recorded comparatively for each of the 36 species. They summed up the most easily observable features of the vegetative and floral parts of the plants in a data matrix. The resulting data set was subjected to analysis under the key-generating program package DELTA (Dallwitz et al., 1993 onwards; Dallwitz and Paine, 2005; Dallwitz, 2010), which builds a printable key to the species in two formats (conventional and tabular), translates the data matrix into natural language to produce detailed descriptions of the species, and prints the characters and character-states of every species in terms of the numbers assigned to them in Table 1 to produce the coded equivalent of the detailed descriptions.

Results

The choice of characters

A set of 48 characters have been selected to construct a special purpose data matrix suitable for generating a conventional key to the 36 species belonging to 21 genera growing spontaneously or grown as garden ornamentals in Egypt. The list of characters in Table 1 and the item (coded) descriptions of the species are a useful substitute of the data matrix. The 48 characters listed in Table 1 have been deliberately picked out from a much wider range of characters exhibited by the 36 species to satisfy the following three conditions:

(i) to be as easily observable by the user of the key as possible without visual aids,
(ii) to be as genetically stable in individual taxa as can be reasonably asserted by examining the largest possible number of specimens of each taxon collected from the widest possible range of its geographical distribution, and
(iii) states of the same character must be as widely separate as possible in order not to cause any confusion between alternative entries of the same couplet in the key.

Characters 1–45 in Table 1 are of the ordered multistate type: only characters 2, 5, 15, 18, 20, 22, 23, 28 and 43 are 3-state or 4-state while the rest are binary. Characters 46–48 are of the real numeric type. Each value of characters 37 and 38 is the average measurement of the largest three leaves in the available specimens of a given species whereas the value of character 39 is the average of the three length/width ratio recorded for every species.

The conventional key

The following is an unedited version of the conventional (*i.e.* printable) key to the 36 species from 21 genera of the Acanthaceae whether growing spontaneously or grown as garden ornamentals and represented by specimens in the Herbaria of CAI and CAIM. The key is preceded by a prelude specifying the different parameters of the run:

(i) the first line shows that 48 characters are in the data matrix (48 indata), of which 45 were included in the anal-

Figs. 1–4 Acanthaceae. Fig. 1, *Barleria cristata*: sagittate bases of 3 staminal filaments. Fig. 2, *Thunbergia alata*: closed globular capsule with long narrow beak (left) and open capsule (right). Fig. 3, *Avicennia marina*: three almond-shaped drupes. Fig. 4, *Ruellia simplex*: elongate beakless capsule (right) and one valve of dehisced capsule with nine retinacula (left). Fig. 1 photographed from resuscitated petals taken from herbarium specimen, Fig. 2 from dry herbarium specimens, Figs. 3 and 4 from fresh material.

ysis (45 included; the three quantitative characters were not used in key construction), and only 28 characters were sufficient to single out every taxon in the key (28 in key),

(ii) the second line indicates that 36 items (taxa) are in the data matrix (36 indata), all 36 taxa (items) were included in the analysis (36 included) and all 36 taxa appeared in the key (36 in key, no taxa are masked),

(iii) the third line shows that each of characters 1–48 was given the default value 5 (out of 10) of character reliability (*i.e.* preference over other characters).

Characters: 48 indata, 45 included, 28 in key.
Items: 36 indata, 36 included, 36 in key.
Character reliabilities: 1–48,5

1. Inflorescence of solitary axillary flowers 2
Inflorescence spike or raceme 13
Inflorescence axillary dichasial cymes 22
Inflorescence unilateral cymes 25

2(1). Base of leaf blade truncate-cordate 3
Base of leaf blade rounded 6
Base of leaf blade cuneate-decurrent 7

3(2). Leaf petiole winged; Corolla lobes pale yellow-orange 4
Leaf petiole not winged; Corolla lobes white-pale or dark blue 5

4(3). Sepals equal; Corolla throat darker than lobes; Appendage on base of one or both anther lobes absent; Staminal filaments glabrous ..... ***Thunbergia alata*Bojer ex Sims.**
Sepals unequal; Corolla throat not darker than lobes; Appendage on base of one or both anther lobes present; Staminal filaments hairy ..... ***Thunbergia gibsonii* S. Moore**

5(3). Anterior corolla lobe variegated; Corolla tube and lobes of different colours; Appendage on base of one or both anther lobes absent ..... ***Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb.**
Anterior corolla lobe not variegated; Corolla tube and lobes of the same colour; Appendage on base of one or both anther lobes present ..... ***Thunbergia fragrans* Roxb.**

6(2). Plant erect ..... ***Thunbergia erecta* (Benth.) T.Anderson**
Plant climbing ..... ***Thunbergia affinis* S. Moore**
Plant prostrate ..... ***Ruellia patula* Jacq.**

7(2). Sepals free 8
Sepals united 9
Sepals only anterior pair united 10

8(7). Bracts linear-lanceolate; Bract apex spiny; Leaf margin dentate; Sepal margin entire and glabrous ..... ***Justicia kotschyi* (Hochst.) Dandy**
Bracts broadly ovate; Bract apex not spiny; Leaf margin entire; Sepal margin entire and ciliate ..... ***Justicia heterocarpa* T. Anders.**

9(7). Bracts linear-lanceolate; Sepals equal; Flowers pedicelled; Bracts of successive flowers not overlapping ..... ***Ruellia simplex* C. Wright**
Bracts broadly ovate; Sepals unequal; Flowers sessile; Bracts of successive flowers overlapping ..... ***Strobilanthes petiolaris* Nees**

10(7). Bracts linear-lanceolate 11
Bracts broadly ovate 12

11(10). Bract blade and veins of the same colour; Bract apex not spiny; Bracts of successive flowers not overlapping; Interpetiolar spines absent ..... ***Barleria hochstetteri* Nees**
Bract veins darker than blade; Bract apex spiny; Bracts of successive flowers overlapping; Interpetiolar spines present ..... ***Barleria prionitis* L.**

12(10). Plant erect; Bract margin laciniate-spiny; Bracts of successive flowers overlapping; Interpetiolar spines absent ..... ***Barleria cristata* L.**
Plant prostrate; Bract margin entire-obscurely dentate; Bracts of successive flowers not overlapping; Interpetiolar spines present ..... ***Barleria acanthoides* Vahl**

13(1). Sepals free 14
Sepals united 20
Sepals only anterior pair united 21

14(13). Petal lobes two 15
Petal lobes four 16
Petal lobes five 18

15(14). Bracts linear-lanceolate; Anterior corolla lobe not variegated; Leaf margin dentate; Leaf apex acute ..... ***Justicia carnea* Lindl.**
Bracts broadly ovate; Anterior corolla lobe variegated; Leaf margin entire; Leaf apex acuminate ..... ***Justicia brandegeeana* Wassh. & L.B.Sm.**

16(14). Plant erect; Bracts broadly ovate; Base of leaf blade cuneate-decurrent; Flowers sessile 17
Plant prostrate; Bracts linear-lanceolate; Base of leaf blade rounded;
Flowers pedicelled ..... ***Pseuderanthemum carruthersii*** **(Seem.) Guillaumin**

17(16). Leaves petiolate; Sepal margin entire and glabrous; Petal lobes equal; Corolla
lobes red ..... ***Pachystachys coccinea*** **Nees**
Leaves sessile-subsessile; Sepal margin entire and ciliate; Petal lobes unequal; Corolla
lobes white-pale or dark blue ..... ***Echolium viride*** **(Forssk.) Alston**

18(14). Plant erect; Anterior corolla lobe not variegated; Bracts of successive flowers not
overlapping; Petal lobes equal 19
Plant prostrate; Anterior corolla lobe variegated; Bracts of successive flowers
overlapping; Petal lobes unequal ..... ***Fittonia gigantea*** **Linden**

19(18). Bracts linear-lanceolate; Base of leaf blade cuneate-decurrent; Sepals equal;
Leaf margin dentate ..... ***Ruellia devosiana*** **E. Morren**
Bracts broadly ovate; Base of leaf blade rounded; Sepals unequal;
Leaf margin entire ..... ***Sanchezia oblonga*** **Ruiz et Pav.**

20(13). Anterior corolla lobe variegated; Leaf apex acuminate; Sepal margin entire and
glabrous; Staminal filaments glabrous ..... ***Lankesteria elegans*** **(P. Beauv.) T. Anderson**
Anterior corolla lobe not variegated; Leaf apex acute; Sepal margin entire and ciliate;
Staminal filaments hairy ..... ***Eranthemum pulchellum*** **Andrews**

21(13). Leaf margin spiny; Sepal margin spiny ..... ***Blepharis edulis*** **(Forssk.) Pers.**
Leaf margin dentate; Sepal margin entire and ciliate ..... ***Blepharis linariifolia*** **Pers.**
Leaf margin entire; Sepal margin entire and glabrous ..... ***Acanthus mollis*** **L.**

22(1). Petal lobes two 23
Petal lobes four ..... ***Avicennia marina*** **(Forssk.) Vierh.**
Petal lobes five 24

23(22). Flowers pedicelled; Corolla lobes white-pale or dark blue; Corolla posterior lobe deflexed;
Fertile stamens four ..... ***Dicliptera paniculata*** **(Forssk.) I. Darbyshire**
Flowers sessile; Corolla lobes red; Corolla posterior lobe vaulted;
Fertile stamens two ..... ***Jacobinia ghiesbreghtiana*** **Hemsl.**

24(22). Base of leaf blade truncate-cordate ..... ***Ruellia tuberosa*** **L.**
Base of leaf blade rounded ..... ***Dipteracanthus rubicaulis*** **Nees**
Base of leaf blade cuneate-decurrent ..... ***Adhatoda vasica*** **Nees**

25(1). Bracts linear-lanceolate; Sepals free; Petal lobes four; Stem nodes
not articulated ..... ***Anisacanthus quadrifidus*** **(Vahl) Nees**
Bracts broadly ovate; Sepals united; Petal lobes two; Stem nodes
articulated ..... ***Hypoestes sanguinolenta*** **(Van Houtte) Hook.**

The tabular key

```
KEY version 2.12 (Java)
Characters - 48 in data, 45 included, 28 in key.
Items - 36 in data, 36 included, 36 in key.

RBASE = 1.40 ABASE = 2.00 REUSE = 1.01 VARYWT = 0.80
Number of confirmatory characters = 3

Average length of key = 3.7 Average cost of key = 3.7
Maximum length of key = 5.0 Maximum cost of key = 5.0

Characters included 1-45
Character reliabilities 1-48,5

Items included 1-36
Item abundances 1-36,5
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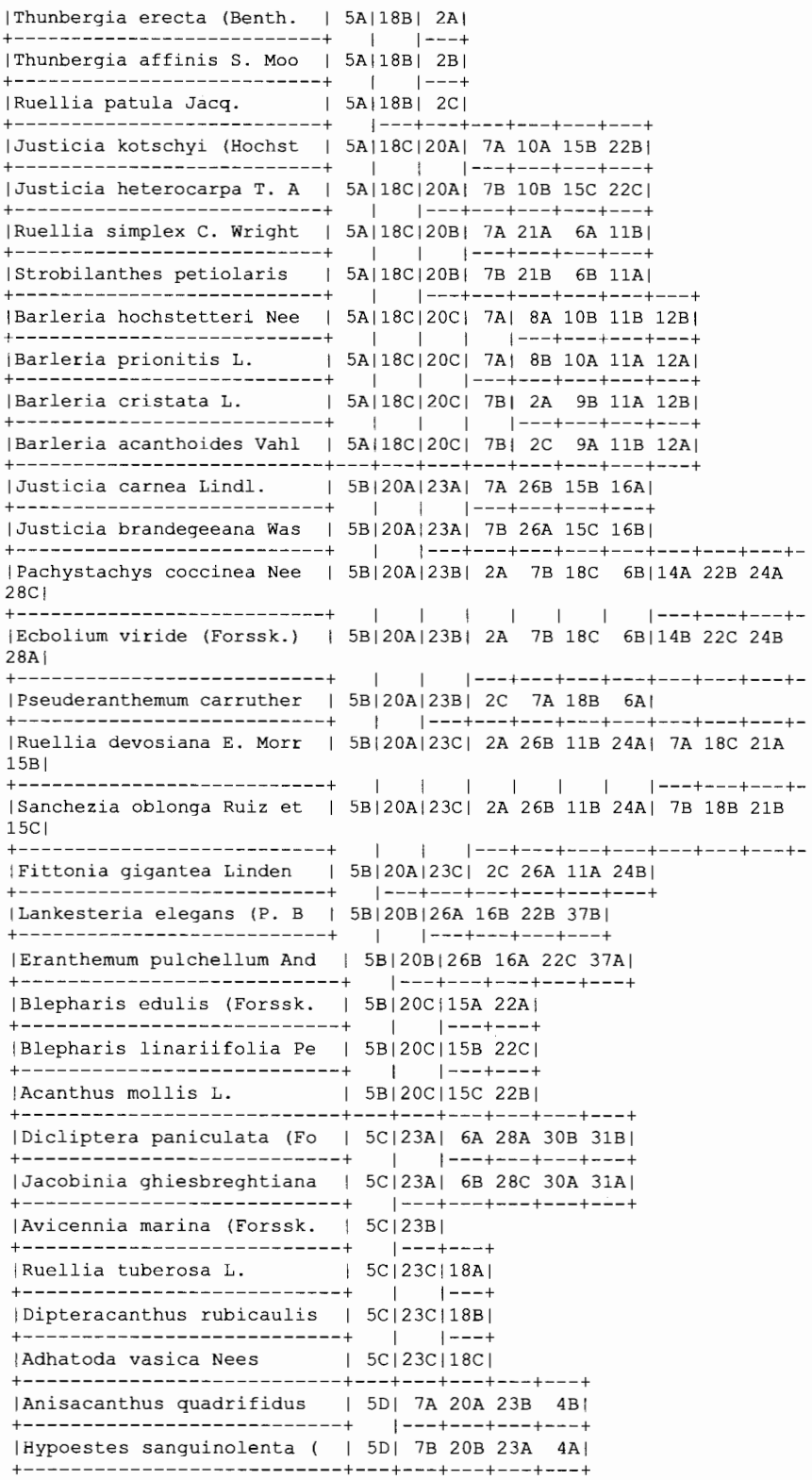
Thunbergia alata Bojer ex	5A	18A	17A	28B	21A	29A	34B	37B
Thunbergia gibsonii S. Mo	5A	18A	17A	28B	21B	29B	34A	37A
Thunbergia grandiflora (R	5A	18A	17B	28A	26A	27B	34B	
Thunbergia fragrans Roxb.	5A	18A	17B	28A	26B	27A	34A	



Detailed descriptions

States of the 48 characters listed in Table 1 and used in generating the conventional key and its bracketed version are scored in natural language for each of the 36 species to form its detailed description. There follows the detailed descriptions of the 36 species arranged alphabetically:

Acanthus mollis L.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes not articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin laciniate-spiny. Bract apex spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves pinnatisect. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers one-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 18.5 cm. Average width of leaf blade 10 cm. Average blade length/width ratio 1.85.

Adhatoda vasica Nees

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence axillary dichasial cymes. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 16 cm. Average width of leaf blade 4.5 cm. Average blade length/width ratio 3.55.

Anisacanthus quadrifidus (Vahl) Nees

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes not articulated. Inflorescence unilateral cymes. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes four. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes red. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style present. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 3.2 cm. Average width of leaf blade 1.2 cm. Average blade length/width ratio 2.66.

Avicennia marina (Forssk.) Vierh.

Plant tree. Plant erect. Pneumatophores present. Stem nodes articulated. Inflorescence axillary dichasial cymes. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes four. Petal lobes equal. Petals thick, leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit drupe. Fruit almond-shaped. Fruit beak small appendage or absent. Retinacula in fruit absent. Average leaf blade length 10 cm. Average width of leaf blade 4 cm. Average blade length/width ratio 2.5.

Barleria acanthoides Vahl

Plant herb or shrub. Plant prostrate. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex spiny. Bracts of successive flowers not overlapping. Interpetiolar spines present. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla

lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments as long as or shorter than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 2.7 cm. Average width of leaf blade 0.8 cm. Average blade length/width ratio 3.37.

Barleria cristata L.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin laciniate-spiny. Bract apex spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 7.9 cm. Average width of leaf blade 2.4 cm. Average blade length/width ratio 3.29.

Barleria hochstetteri Nees

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin entire and ciliate. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 4.2 cm. Average width of leaf blade 0.75 cm. Average blade length/width ratio 5.6.

Barleria prionitis L.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts linear-lanceolate. Bract veins darker than blade. Bract margin entire-obscurely dentate. Bract apex spiny. Bracts of successive flowers overlapping. Interpetiolar spines present. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 9.3 cm. Average width of leaf blade 4.2 cm. Average blade length/width ratio 2.21.

Blepharis edulis (Forssk.) Pers.

Plant herb or shrub. Plant prostrate. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin laciniate-spiny. Bract apex spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves sessile-subsessile. Leaf margin spiny. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin spiny. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament present. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 3.5 cm. Average width of leaf blade 1.5 cm. Average blade length/width ratio 2.33.

Blepharis linariifolia Pers.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin laciniate-spiny. Bract apex spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves sessile-subsessile. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals only anterior pair united. Sepals unequal. Sepal margin entire and ciliate. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament present. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 6.5 cm. Average width of leaf blade 0.3 cm. Average blade length/width ratio 21.56.

Dicliptera paniculata (Forssk.) I. Darbyshire

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence axillary dichasial cymes. Flowers pedicelled. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes two. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments as long as or shorter than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 4.5 cm. Average width of leaf blade 2.1 cm. Average blade length/width ratio 2.14.

Dipteracanthus rubicaulis Nees

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence axillary dichasial cymes. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and ciliate. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments as long as or shorter than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit absent. Average leaf blade length 9.5 cm. Average width of leaf blade 5.3 cm. Average blade length/width ratio 1.79.

Ecbolium viride (Forssk.) Alston

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves sessile-subsessile. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and ciliate. Petal lobes four. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 8.9 cm. Average width of leaf blade 3.5 cm. Average blade length/width ratio 2.54.

Eranthemum pulchellum Andrews

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract veins darker than blade. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals united. Sepals equal. Sepal margin entire and ciliate. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not

darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 17.5 cm. Average width of leaf blade 6.7 cm. Average blade length/width ratio 2.61.

Fittonia gigantea Linden

Plant herb or shrub. Plant prostrate. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf veins much lighter than blade. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 14.5 cm. Average width of leaf blade 9.1 cm. Average blade length/width ratio 1.59.

Hypoestes sanguinolenta (Van Houtte) Hook.f.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence unilateral cymes. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals united. Sepals equal. Sepal margin entire and ciliate. Petal lobes two. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes red. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf veins much lighter than blade. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 6.4 cm. Average width of leaf blade 3.2 cm. Average blade length/width ratio 2.

Jacobinia ghiesbreghtiana Hemsl.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence axillary dichasial cymes. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes two. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes red. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 9.4 cm. Average width of leaf blade 3.6 cm. Average blade length/width ratio 2.61.

Justicia brandegeeana Wassh. & L.B.Sm.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acuminate. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and ciliate. Petal lobes two. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 5.9 cm. Average width of leaf blade 3 cm. Average blade length/width ratio 1.96.

Justicia carnea Lindl.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same

colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes two. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes red. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 21.3 cm. Average width of leaf blade 7.9 cm. Average blade length/width ratio 2.69.

Justicia heterocarpa T. Anders.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and ciliate. Petal lobes four. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 2.9 cm. Average width of leaf blade 1.4 cm. Average blade length/width ratio 2.07.

Justicia kotschyi (Hochst.) Dandy

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes four. Petal lobes unequal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe vaulted. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 5.2 cm. Average width of leaf blade 1.59 cm. Average blade length/width ratio 3.26.

Lankesteria elegans (P. Beauv.) T. Anderson

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract veins darker than blade. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acuminate. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals united. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style present. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 9.3 cm. Average width of leaf blade 4.6 cm. Average blade length/width ratio 2.2.

Pachystachys coccinea Nees

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes four. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes red. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf blade

and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 16 cm. Average width of leaf blade 4.2 cm. Average blade length/width ratio 3.81.

Pseuderanthemum carruthersii (Seem.) Guillaumin

Plant herb or shrub. Plant prostrate. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers pedicelled. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes four. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes red. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 11 cm. Average width of leaf blade 7.5 cm. Average blade length/width ratio 1.46.

Ruellia devosiana E. Morren

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style present. Leaf veins much lighter than blade. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 8.6 cm. Average width of leaf blade 1.5 cm. Average blade length/width ratio 5.37.

Ruellia patula Jacq.

Plant herb or shrub. Plant prostrate. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire and ciliate. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 2.8 cm. Average width of leaf blade 2.3 cm. Average blade length/width ratio 1.21.

Ruellia simplex C. Wright

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals united. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 12.5 cm. Average width of leaf blade 3.8 cm. Average blade length/width ratio 3.29.

Ruellia tuberosa L.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence axillary dichasial cymes. Flowers pedicelled. Bracts linear-lanceolate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade truncate-cordate. Leaf primary veins pinnate. Sepals free. Sepals equal. Sepal margin entire

and ciliate. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 11 cm. Average width of leaf blade 7.8 cm. Average blade length/width ratio 1.41.

Sanchezia oblonga Ruiz et Pav.

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence spike or raceme. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals free. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens two. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers exserted. Glandular hairs on style absent. Leaf veins much lighter than blade. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 10 cm. Average width of leaf blade 6.1 cm. Average blade length/width ratio 1.64.

Strobilanthes petiolaris Nees

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers sessile. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers overlapping. Interpetiolar spines absent. Leaves simple. Leaves sessile-subsessile. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade cuneate-decurrent. Leaf primary veins pinnate. Sepals united. Sepals unequal. Sepal margin entire and ciliate. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of different colours. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit absent. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments as long as or shorter than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit elongate. Fruit beak small appendage or absent. Retinacula in fruit present. Average leaf blade length 9.9 cm. Average width of leaf blade 2.8 cm. Average blade length/width ratio 3.53.

Thunbergia affinis S. Moore

Plant herb or shrub. Plant climbing. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole not winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals united. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of different colours. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style present. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit globular. Fruit beak as long as fruit. Retinacula in fruit absent. Average leaf blade length 7.5 cm. Average width of leaf blade 4.5 cm. Average blade length/width ratio 1.66.

Thunbergia alata Bojer ex Sims.

Plant herb or shrub. Plant climbing. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole winged. Base of leaf blade truncate-cordate. Leaf primary veins palmate. Sepals united. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit globular. Fruit beak as long as fruit. Retinacula in fruit absent. Average leaf blade length 8.9 cm. Average width of leaf blade 6 cm. Average blade length/width ratio 1.38.

Thunbergia erecta (Benth.) T. Anderson

Plant herb or shrub. Plant erect. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin entire. Leaf apex acute. Leaf petiole winged. Base of leaf blade rounded. Leaf primary veins pinnate. Sepals united. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of different colours. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style present. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit globular. Fruit beak as long as fruit. Retinacula in fruit absent. Average leaf blade length 5.3 cm. Average width of leaf blade 2.7 cm. Average blade length/width ratio 1.96.

Thunbergia fragrans Roxb.

Plant herb or shrub. Plant climbing. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade truncate-cordate. Leaf primary veins palmate. Sepals united. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit globular. Fruit beak as long as fruit. Retinacula in fruit absent. Average leaf blade length 7.9 cm. Average width of leaf blade 6 cm. Average blade length/width ratio 1.33.

Thunbergia gibsonii S. Moore

Plant herb or shrub. Plant climbing. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole winged. Base of leaf blade truncate-cordate. Leaf primary veins palmate. Sepals united. Sepals unequal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe not variegated. Corolla tube and lobes of the same colour. Corolla lobes pale yellow-orange. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes present. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments hairy. Staminal filaments as long as or shorter than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit globular. Fruit beak as long as fruit. Retinacula in fruit absent. Average leaf blade length 3.9 cm. Average width of leaf blade 2.7 cm. Average blade length/width ratio 1.44.

Thunbergia grandiflora (Roxb. ex Rottl.) Roxb.

Plant herb or shrub. Plant climbing. Pneumatophores absent. Stem nodes articulated. Inflorescence of solitary axillary flowers. Flowers pedicelled. Bracts broadly ovate. Bract blade and veins of the same colour. Bract margin entire-obscurely dentate. Bract apex not spiny. Bracts of successive flowers not overlapping. Interpetiolar spines absent. Leaves simple. Leaves petiolate. Leaf margin dentate. Leaf apex acute. Leaf petiole not winged. Base of leaf blade truncate-cordate. Leaf primary veins palmate. Sepals united. Sepals equal. Sepal margin entire and glabrous. Petal lobes five. Petal lobes equal. Petals thin, not leathery. Anterior corolla lobe variegated. Corolla tube and lobes of different colours. Corolla lobes white-pale or dark blue. Corolla throat not darker than lobes. Corolla posterior lobe deflexed. Fertile stamens four. Thick tuft of hairs along anther dehiscence slit present. Anthers two-lobed. Appendage on base of one or both anther lobes absent. Lateral extension of staminal filament absent. Base of each staminal filament not sagittate. Staminal filaments glabrous. Staminal filaments much longer than anthers. Anthers included. Glandular hairs on style absent. Leaf blade and veins homogeneously green. Fruit septicidal capsule. Fruit globular. Fruit beak as long as fruit. Retinacula in fruit absent. Average leaf blade length 9.9 cm. Average width of leaf blade 4.5 cm. Average blade length/width ratio 2.19.

Item descriptions

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# \i\b{}Acanthus mollis \i0{}L.\b0{}/
1,2 2,1 3,2 4,2 5,2 6,2 7,2 8,1 9,2 10,1 11,2 12,2 13,2 14,1 15,3 16,1
17,2 18,3 19,1 20,3 21,2 22,2 23,3 24,2 25,2 26,2 27,1 28,1 29,2
30,1 31,2 32,1 33,2 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,18.5 47,10 48,1.85
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(continued on next page)

\i\b{}Adhatoda vasica \i0{}Nees\b0{}/
1,2 2,1 3,2 4,1 5,3 6,2 7,2 8,1 9,1 10,2 11,1 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,3 24,2 25,2 26,1 27,1 28,1 29,2
30,1 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,16 47,4.5 48,3.55

\i\b{}Anisacanthus quadrifidus \i0{}(Vahl) Nees\b0{}/
1,2 2,1 3,2 4,2 5,4 6,2 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,2 19,1 20,1 21,1 22,2 23,2 24,1 25,2 26,2 27,1 28,3 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,1 38,2 39,1 40,1 41,2 42,2
43,3 44,2 45,1 46,3.2 47,1.2 48,2.66

\i\b{}Avicennia marina \i0{}(Forssk.) Vierh.\b0{}/
1,1 2,1 3,1 4,1 5,3 6,2 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,2 24,1 25,1 26,2 27,1 28,2 29,2
30,2 31,2 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,1
43,2 44,2 45,2 46,10 47,4 48,2.5

\i\b{}Barleria acanthoides \i0{}Vahl\b0{}/
1,2 2,3 3,2 4,1 5,1 6,2 7,2 8,1 9,1 10,1 11,2 12,1 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,3 21,2 22,2 23,3 24,2 25,2 26,2 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,1 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,2.7 47,0.8 48,3.37

\i\b{}Barleria cristata \i0{}L.\b0{}/
1,2 2,1 3,2 4,1 5,1 6,2 7,2 8,1 9,2 10,1 11,1 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,3 21,2 22,2 23,3 24,2 25,2 26,2 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,1 37,1 38,2 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,7.9 47,2.4 48,3.29

\i\b{}Barleria hochstetteri \i0{}Nees\b0{}/
1,2 2,1 3,2 4,1 5,1 6,2 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,3 21,2 22,3 23,3 24,1 25,2 26,2 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,4.2 47,0.75 48,5.6

\i\b{}Barleria prionitis \i0{}L.\b0{}/
1,2 2,1 3,2 4,1 5,1 6,2 7,1 8,2 9,1 10,1 11,1 12,1 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,3 21,2 22,2 23,3 24,2 25,2 26,2 27,1 28,2 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,1 38,2 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,9.3 47,4.2 48,2.21

\i\b{}Blepharis edulis \i0{}(Forssk.) Pers.\b0{}/
1,2 2,3 3,2 4,1 5,2 6,2 7,2 8,1 9,2 10,1 11,1 12,2 13,1 14,2 15,1 16,1
17,2 18,3 19,1 20,3 21,2 22,1 23,3 24,2 25,2 26,1 27,1 28,1 29,2
30,1 31,2 32,1 33,1 34,2 35,1 36,2 37,1 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,3.5 47,1.5 48,2.33

\i\b{}Blepharis linariifolia \i0{}Pers.\b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,1 9,2 10,1 11,1 12,2 13,1 14,2 15,2 16,1
17,2 18,3 19,1 20,3 21,2 22,3 23,3 24,2 25,2 26,1 27,1 28,1 29,2
30,1 31,2 32,1 33,1 34,2 35,1 36,2 37,1 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,6.5 47,0.3 48,21.56

\i\b{}Dicliptera paniculata \i0{}(Forssk.) I. Darbyshire b0{}/
1,2 2,1 3,2 4,1 5,3 6,1 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,1 24,2 25,2 26,2 27,1 28,1 29,2
30,2 31,2 32,2 33,1 34,2 35,2 36,2 37,2 38,1 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,4.5 47,2.1 48,2.14

\i\b{}Dipteracanthus rubicaulis \i0{}Nees\b0{}/
1,2 2,1 3,2 4,1 5,3 6,2 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,2 19,1 20,1 21,1 22,3 23,3 24,1 25,2 26,2 27,1 28,2 29,2
30,2 31,2 32,2 33,1 34,2 35,2 36,2 37,2 38,1 39,1 40,2 41,2 42,2
43,3 44,2 45,2 46,9.5 47,5.3 48,1.79

\i\b{}Ecbolium viride \i0{}(Forssk.) Alston\b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,1 9,1 10,2 11,1 12,2 13,1 14,2 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,3 23,2 24,2 25,2 26,2 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,1 38,2 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,8.9 47,3.5 48,2.54

\i\b{}Eranthemum pulchellum \i0{}Andrews\b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,2 9,1 10,2 11,1 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,2 21,1 22,3 23,3 24,1 25,2 26,2 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,1 38,2 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,17.5 47,6.7 48,2.61

\i\b{}Fittonia gigantea \i0{}Linden\b0{}/
1,2 2,3 3,2 4,1 5,2 6,2 7,2 8,1 9,1 10,2 11,1 12,2 13,1 14,1 15,3 16,1
17,2 18,2 19,1 20,1 21,1 22,2 23,3 24,2 25,2 26,1 27,1 28,2 29,2
30,1 31,1 32,2 33,1 34,2 35,2 36,2 37,1 38,2 39,2 40,2 41,1 42,2
43,3 44,2 45,1 46,14.5 47,9.1 48,1.59

\i\b{}Hypoestes sanguinolenta \i0{}(Van Houtte) Hook. i{}
f. i0 b0{}/
1,2 2,1 3,2 4,1 5,4 6,2 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,2 19,1 20,2 21,1 22,3 23,1 24,2 25,2 26,2 27,1 28,3 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,1 38,2 39,1 40,2 41,1 42,2
43,3 44,2 45,1 46,6.4 47,3.2 48,2

\i\b{}Jacobinia ghiesbreghtiana \i0{}Hemsl.\b0{}/
1,2 2,1 3,2 4,1 5,3 6,2 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,1 24,2 25,2 26,2 27,1 28,3 29,2
30,1 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,9.4 47,3.6 48,2.61

\i\b{}Justicia brandegeeana \i0{}Wassh. & L.B.Sm. b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,1 9,1 10,2 11,1 12,2 13,1 14,1 15,3 16,2
17,2 18,3 19,1 20,1 21,1 22,3 23,1 24,2 25,2 26,1 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,1 35,2 36,2 37,1 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,5.9 47,3 48,1.96

\i\b{}Justicia carnea \i0{}Lindl.\b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,1 8,1 9,1 10,2 11,1 12,2 13,1 14,1 15,2 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,1 24,2 25,2 26,2 27,1 28,3 29,2
30,1 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,21.3 47,7.9 48,2.69

\i\b{}Justicia heterocarpa \i0{}T. Anders.\b0{}/
1,2 2,1 3,2 4,1 5,1 6,2 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,3 23,2 24,2 25,2 26,1 27,1 28,1 29,2
30,1 31,1 32,2 33,1 34,1 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,2.9 47,1.4 48,2.07

\i\b{}Justicia kotschyi \i0{}(Hochst.) Dandy\b0{}/
1,2 2,1 3,2 4,1 5,1 6,2 7,1 8,1 9,1 10,1 11,2 12,2 13,1 14,1 15,2 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,2 24,2 25,2 26,1 27,1 28,1 29,2
30,1 31,1 32,2 33,1 34,1 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2
43,3 44,2 45,1 46,5.2 47,1.59 48,3.26

\i\b{}Lankesteria elegans \i0{}(P. Beauv.) T. Anderson b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,2 9,1 10,2 11,1 12,2 13,1 14,1 15,3 16,2
17,2 18,3 19,1 20,2 21,1 22,2 23,3 24,1 25,2 26,1 27,1 28,1 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,1 41,2 42,2
43,3 44,2 45,1 46,9.3 47,4.6 48,2.2

\i\b{}Pachystachys coccinea\i0{} Nees\b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,1 9,1 10,2 11,1 12,2 13,1 14,1 15,3 16,1
17,2 18,3 19,1 20,1 21,1 22,2 23,2 24,1 25,2 26,2 27,1 28,3 29,2
30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,1 40,2 41,2 42,2
43,3 44,2 45,1 46,16 47,4.2 48,3.81

\i\b{}Pseuderanthemum carruthersii \i0{}(Seem.) Guillaumin\b0{}/
1,2 2,3 3,2 4,1 5,2 6,1 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,2 18,2 19,1 20,1 21,1 22,2 23,2 24,1 25,2 26,2 27,1 28,3 29,2 30,2 31,1 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,3 44,2 45,1 46,11 47,7.5 48,1.46

\i\b{}Ruellia devosiana \i0{}E. Morren\b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,2 16,1 17,2 18,3 19,1 20,1 21,1 22,2 23,3 24,1 25,2 26,2 27,1 28,1 29,2 30,2 31,2 32,2 33,1 34,1 35,2 36,2 37,2 38,2 39,2 40,1 41,1 42,2 43,3 44,2 45,1 46,8.6 47,1.5 48,5.37

\i\b{}Ruellia patula \i0{}Jacq.\b0{}/
1,2 2,3 3,2 4,1 5,1 6,2 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,2 18,2 19,1 20,1 21,1 22,3 23,3 24,1 25,2 26,2 27,1 28,1 29,2 30,2 31,2 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,3 44,2 45,1 46,2.8 47,2.3 48,1.21

\i\b{}Ruellia simplex \i0{}C. Wright\b0{}/
1,2 2,1 3,2 4,1 5,1 6,1 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,2 18,3 19,1 20,2 21,1 22,2 23,3 24,1 25,2 26,2 27,1 28,1 29,2 30,2 31,2 32,2 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,3 44,2 45,1 46,12.5 47,3.8 48,3.29

\i\b{}Ruellia tuberosa \i0{}L.\b0{}/
1,2 2,1 3,2 4,1 5,3 6,1 7,1 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,2 18,1 19,1 20,1 21,1 22,3 23,3 24,1 25,2 26,2 27,1 28,1 29,2 30,2 31,2 32,2 33,1 34,1 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,3 44,2 45,1 46,11 47,7.8 48,1.41

\i\b{}Sanchezia oblonga \i0{}Ruiz et Pav. b0{}/
1,2 2,1 3,2 4,1 5,2 6,2 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,2 18,2 19,1 20,1 21,2 22,2 23,3 24,1 25,2 26,2 27,1 28,2 29,2 30,2 31,1 32,1 33,1 34,2 35,2 36,2 37,1 38,2 39,1 40,2 41,1 42,2 43,3 44,2 45,1 46,10 47,6.1 48,1.64

\i\b{}Strobilanthes petiolaris \i0{}Nees\b0{}/
1,2 2,1 3,2 4,1 5,1 6,2 7,2 8,1 9,1 10,2 11,1 12,2 13,1 14,2 15,2 16,1 17,2 18,3 19,1 20,2 21,2 22,3 23,3 24,1 25,2 26,2 27,2 28,1 29,2 30,2 31,2 32,2 33,1 34,2 35,2 36,2 37,1 38,1 39,2 40,2 41,2 42,2 43,3 44,2 45,1 46,9.9 47,2.8 48,3.53

\i\b{}Thunbergia affinis \i0{}S. Moore\b0{}/
1,2 2,2 3,2 4,1 5,1 6,1 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,2 18,2 19,1 20,2 21,2 22,2 23,3 24,1 25,2 26,2 27,2 28,1 29,2 30,2 31,2 32,1 33,1 34,1 35,2 36,2 37,1 38,2 39,2 40,1 41,2 42,2 43,1 44,1 45,2 46,7.5 47,4.5 48,1.66

\i\b{}Thunbergia alata \i0{}Bojer ex Sims. b0{}/
1,2 2,2 3,2 4,1 5,1 6,1 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,2 16,1 17,1 18,1 19,2 20,2 21,1 22,2 23,3 24,1 25,2 26,2 27,1 28,2 29,1 30,2 31,2 32,1 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,1 44,1 45,2 46,8.9 47,6 48,1.38

\i\b{}Thunbergia erecta \i0{}(Benth.) T. Anderson b0{}/
1,2 2,1 3,2 4,1 5,1 6,1 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,3 16,1 17,1 18,2 19,1 20,2 21,1 22,2 23,3 24,1 25,2 26,2 27,2 28,1 29,2 30,2 31,2 32,1 33,1 34,1 35,2 36,2 37,1 38,2 39,2 40,1 41,2 42,2 43,1 44,1 45,2 46,5.3 47,2.7 48,1.96

\i\b{}Thunbergia fragrans \i0{}Roxb.\b0{}/
1,2 2,2 3,2 4,1 5,1 6,1 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,2 16,1 17,2 18,1 19,2 20,2 21,1 22,2 23,3 24,1 25,2 26,2 27,1 28,1 29,2 30,2 31,2 32,1 33,1 34,1 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,1 44,1 45,2 46,7.9 47,6 48,1.33

\i\b{}Thunbergia gibsonii\i0{} S. Moore b0{}/
1,2 2,2 3,2 4,1 5,1 6,1 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,2 16,1 17,1 18,1 19,2 20,2 21,2 22,2 23,3 24,1 25,2 26,2 27,1 28,2 29,2 30,2 31,2 32,1 33,1 34,1 35,2 36,2 37,1 38,1 39,2 40,2 41,2 42,2 43,1 44,1 45,2 46,3.9 47,2.7 48,1.44

\i\b{}Thunbergia grandiflora \i0{}(Roxb. ex Rottl.) Roxb. b0{}/
1,2 2,2 3,2 4,1 5,1 6,1 7,2 8,1 9,1 10,2 11,2 12,2 13,1 14,1 15,2 16,1 17,2 18,1 19,2 20,2 21,1 22,2 23,3 24,1 25,2 26,1 27,2 28,1 29,2 30,2 31,2 32,1 33,1 34,2 35,2 36,2 37,2 38,2 39,2 40,2 41,2 42,2 43,1 44,1 45,2 46,9.9 47,4.5 48,2.19

Discussion

The key constructed in the present study to the 36 species (from 21 genera) of the Acanthaceae *s.l.* in Egypt covers the 10 spontaneous species and 26 species grown as garden ornamentals. As such, it serves the identificatory purposes for not only students and researches in the various fields of botanical enquiry, but also horticulturists and gardeners. It is one of the peculiar ironies of botanical research that nearly all efforts were directed towards the identification of wild plants which represent a small fraction of the flora of the world, while the correct identification of the small minority of cultivated plants was grossly neglected. To this extent, the present study may be regarded as a step, small as it may be, in the right direction as it attempts to attract the attention of taxonomists to the need for bridging this clear gap in botanical knowledge. Furthermore, the key to the ten spontaneous species is a major improvement over previous keys to members of the Acanthaceae in Egypt. Distinction between alternative entries of 16 of the 25 couplets is based on a combination of correlated characters while the rest are based on differences in single but well-defined and easily observable characters. Unlike previous keys, the present key leads directly to the full name of any taxon together with its author citation thus expediting the identification process. It is worth noting that the program suite DELTA produces not only conventional keys but also "interactive keys" or "e-keys" which can be uploaded on a website for global as well as local usage.

The prelude to the key indicates that all 36 species included in the original data matrix have been included in the key; none of the species was masked or omitted. Only 28 of the 48 characters recorded comparatively for each of the 36 species were sufficient to enable the DELTA program suite to single out each species at the end of its own entry in the key. Furthermore, the bracketed version of the key shows that the number of characters required to identify a species was as low as two in the case of *Avicennia marina* (Inflorescence axillary dichasial cymes, petal lobes 4), while the highest number needed to arrive at the name of a species is 11 in the case of *Pachystachys coccinea* and *Ecbolium viride*. If the characters used to identify a species are excluded from the 48 characters recorded for it, the remaining characters featuring in its detailed descriptions can serve the highly important function of confirming that identification.

The list of characters in Table 1 could have been vastly expanded if we had resorted to the use of microscopic characters to benefit from the wide range of variation in the types and distribution of epidermal trichomes, calcium carbonate

cystoliths, calcium oxalate crystals in the leaves, bracts and sepals of the plants or even the much wider range of variation in pollen morphological features in the process of key generation. Such microscopic characters were deliberately avoided so that only a few of the 48 recorded characters (thick tuft of hairs along anther opening slit; anthers 2-lobed/1-lobed; apical appendage on each anther lobe; base of each staminal filament sagittate; staminal filaments hairy/glabrous; glandular hairs on style) might require the use of a hand lens to be observed accurately in species with relatively small flowers. Therefore, the key provided in the present study is equally useful in laboratories and botanic gardens as well as on field excursions. Furthermore, all characters and their states were accurately and lucidly defined so that the key is equally usable by professional and amateur botanists.

It is worth noting that some populations of *Avicennia marina* are capable of growing on inland sand dunes where they lose two of the adaptations to the harsh conditions of the mangrove environment in the inter-tidal zones: the pneumatophores and vivipary of seeds (El-Gazzar, 2009). However, this ecologically-induced change in two of the plant's characters should not affect the validity of the key provided in the present study because *A. marina* is separated from the rest of the 36 species in the key by a definitive combination of two other characters (inflorescence axillary dichasial cymes, petal lobes 4) and the remaining 46 characters in the detailed descriptions should adequately confirm that separation. A similar loss of pneumatophores owing to the growth of *Acanthus ilicifolius* on sandy soil in a temperate environment at an altitude of 2034 m asl instead of its usual habitat along the sea coasts of India, Sri Lanka, the Philippines, Malaysia, Australia and South Africa, was also reported by Chhetri (2002).

The method of generating identification keys using the DELTA suite of computer programs or a similar program package is advantageous to constructing such keys manually. Computer-generated keys are a marked improvement over the manually constructed ones in several respects: (i) the former lead directly to the full names of taxa instead of having to determine the generic name by one key and the specific and infra-specific names (if any) of a taxon by one or more keys, (ii) a benefit gained from the comparative recording of the characters in the data matrix is that the entries of any couplet in the key are separated from each other on the basis of the contrasting state(s) of the same character(s) thus facilitating the user's task of deciding which entry fits best the unknown specimen(s), (iii) the same computer-generated key and the accompanying detailed descriptions can serve the dual function of identifying taxa and confirm their identity as only a few of the characters recorded comparatively for the taxa are sufficient to single out a given taxon and the rest of its characters can be found in its detailed description to support its correct identification, (iv) the data matrix provided in the present study (as coded descriptions of the species) is so flexible that it can serve as a useful basis for similar floristic studies in other parts of the world as well as in the preparation of monographs of individual genera through modification to suite the wild and/or cultivated representatives of the family or any of its subordinate groupings.

Appendix A

Updated nomenclature and collection data of specimens representing 36 species belonging to 21 genera of Acanthaceae growing spontaneously (asterisked) or as garden ornamentals in Egypt. Author citations with original publication details are according to the website: [www.theplantlist.org]. Genera and species are in alphabetical order.

	Taxa	Collection data
1	*Acanthus mollis* L., Sp. Pl. 2: 639, 1753	Adolf Croneborg, *s.n.*; 16/5/1964; Roda Island, in a garden at the southern end of the island, Cairo
2	*Adhatoda vasica* Nees, Pl. Asiat. Rar. 3: 103, 1832	Gunnar Taeckholm, *s.n*; 25/3/1926; cultivated in the University Park, Zaafaran Palace, Cairo M. Hassib, *s.n.*; 5/4/1928; Orman Garden, Giza Adel El-Gazzar; *s.n.*; 18/2/2015; garden of Tanta Univ., Egypt
3	*Anisacanthus quadrifidus* (Vahl) Nees, Linnaea 16: 307, 1842	Mohamed El Mahdi, *s.n.*; 8/12/1963; Zoological Garden, Giza M.T. Hefnawy; *s.n.*; 15/1/1929; Giza
4	*Avicennia marina* (Forsk.) Vierh., Denksch. Akad. Wiss., Wien. Math-Naturwiss. Kl. 71: 435, 1907*	Kassas, 865, 15/12/1954, Red Sea, near Mersa Darur, Sudan Y. Sabet and A. Nayal, *s.n.*, July 1933, Red Sea, Ghardaga, Egypt Adel El-Gazzar, M. Demerdash, S.Z. Heneidy, H. El-Kady; *s.n.*; 6/2/1992; Nabaq, Gulf of Aqaba; S. Sinai, Egypt Adel El-Gazzar, M. Demerdash, S.Z. Heneidy, H. El-Kady; *s.n.*;14/3/1993; Ras Mohammad, Gulf of Aqaba; S. Sinai, Egypt
5	*Barleria acanthoides* Vahl, Symb. Bot. 1: 47, 1790*	M. Kassas, M.O. Mobarak, B. Fadlallah, H.A. Omar and M. Osman, E 96, 7/12/1967, Jebel Avitola – Khor Tagando, Kassala, Sudan M. Kassas, 625, 12/9/1954, Khor Abu Muheirib, Sudan
6	*Barleria cristata* L., Sp. Pl. 2: 636, 1753	M. T. Hefnawy; *s.n.*; 25/12/1928; Zohriya Garden, Giza Mohamed El Mahdi; *s.n.*; 14/11/1972; Orman Garden, Giza
7	*Barleria hochstetteri* Nees, Prodr. 11: 231, 1847*	V. Tackholm, M. Kassas, H. Fawzy, F. Shalaby, M. Samy, M. A. Zahran; *s.n.*; 20/1/1962; Gebel Elba, Egypt M. Kassas, M. O. Mobarak, B. Fadlalla, H. A. Omar, M. Osman; E962; 27/2/1967;

(*continued*)

	Taxa	Collection data
		Eastern Sudan M. Hassib; 739; 29/1/1933; Gebel Elba, Egypt
8	*Barleria prionitis* L., Sp. Pl. 2: 636, 1753	V. Täckholm; 126; 2/11/1959; Faculty of Agriculture; Cairo
9	*Blepharis edulis* (Forssk.) Pers., Syn. Pl. 2: 180, 1806*	D. Abdulla El Sheikh; 206; 1/8/1975; Saudi Arabia Adel El-Gazzar, S.Z. Heneidy, M. Demerdash, H. El-Kady; *s.n.*;18/3/1992; Wadi Kid, Gulf of Aqaba; S. Sinai, Egypt
10	*Blepharis linariifolia* Pers., Syn. Pl. 2: 180, 1806*	Kamal Ibrahim, *s.n.*, 27/7/1958, Sudan. Pfund, *s.n.*, 1875–1876, Om Erbah, Kordofan, Sudan
11	*Dicliptera paniculata* (Forssk.) I. Derbysh., Kew Bull. 62: 122, 2007*	V. Tackholm, M. Kassas, H. Fawzy, F. Shalaby, M. Samy, M. A. Zahran; 495; 24/1/1962; Gebel Elba district, Egypt V. Tackholm, M. Kassas, M. Samy, W. A. Girgis, M. A. Zahran; 351; 7/2/1961; Gebel Hamata, Red Sea, Egypt
12	*Dipteracanthus rubicaulis* Nees, Prodr. 11: 116, 1847	Ezz El Din; *s.n.*; 10/9/1970; Faculty of Agriculture, Cairo
13	*Echolium viride* (Forssk.) Alston, Fl. Ceylon 6(suppl.): 229, 1931*	Christina Brydolf, *s.n.*, February 1967, Madagascar
14	*Eranthemum pulchellum* Andrews, Bot. Repos. 2: t.88, 1800	M. Drar; *s.n.*; 4/12/1960; Gabaris, near Itai El-Barud, Beheira, Egypt M. El Mahdi; *s.n.*; 24/2/1964; Agricultural Museum Garden, Dokki, Egypt V. Tackholm; *s.n.*; 27/5/1961; Alfred Bircher's garden, El Saff, Egypt M. El Mahdi; 104; 23/5/1969; Aswan, Egypt
15	*Fittonia gigantea* Lindau, Rev. Hort. 41: 186, 1869	M. El Mahdi; 882; 3/9/1963; Zohria Garden, Gezira, Cairo
16	*Hypoestes sanguinolenta* (Van Houtte) Hook.*f*., Bot. Mag. 91: t. 5511, 1865	Ezz El Din; *s.n*; 21/10/1969; Zohria Garden, Cairo Ezz El Din; 124; 25/11/1969; Zohria Garden, Cairo
17	*Jacobinia ghiesbreghtiana* Hemsl., Biol. Cent.-Amer., Bot. 2(12): 520, 1882	M. El Mahdi; *s.n.*; 27/8/1973; Cairo University Garden
18	*Justicia brandegeeana* Wassh. & L.B. Sm., Fl. Illustr. Catar. 1(Acantac.): 102, 1969	V. Tackholm; *s.n.*; 17/11/1959; Zohria Garden, Cairo
19	*Justicia carnea* Lindl., Edward's Bot. Reg. 17: t. 1397, 1831	M. El Mahdi; 400; 3/9/1963; Zohria Garden, Cairo
20	*Justicia heterocarpa* T. Anders., J. Proc. Linn. Soc., Bot. 7: 41, 1864*	M. Drar; 545; 10/3/1938; Gebl Sila, Sudan V. Tackholm, M. Kassas, H. Fawzy, F. Shalaby, M. Samy, M. A. Zahran; *s.n.*; 21/1/1962; Gebl Elba, Egypt

(*continued*)

	Taxa	Collection data
		V. Tackholm, M. Kassas, H. Fawzy, F. Shalaby, M. Samy, M. A. Zahran; 504; 20/1/1962; Gebl Elba, Egypt
21	*Justicia kotschyi* (Hochst.) Dandy, Fl. Pl. Sudan 3: 180, 1956*	M. Kassas, M. O. Mobarak, H. A. Omar; 413; 10/12/1966; Khor Gwob, Red Sea district, Sudan M. Kassas, M. O. Mobarak, H. A. Omar; *s.n.*; 14/12/1966; Jebel Asotriba, Port Sudan, Sudan
22	*Lankesteria elegans* (P. Beauv.)T. Anderson, J. Proc. Linn. Soc., Bot. 7: 33, 1864	S. Kishk; 169; 27/1/1971; Plant Island, Aswan
23	*Pachystachys coccinea* Nees, Prodr. 11: 319, 1847	M. El Mahdi; s.n.; 7/8/1963; Zohria Garden, Cairo
24	*Pseuderanthemum carruthersii* (Seem.) Guillaumin, Ann. Mus. Colon. Marseille VI, 5–6: 48, 1948	Ezz El Din; *s.n.*; 17/4/1971; Zohria Garden, Cairo
25	*Ruellia devosiana* E. Morren, Ann. Bot. Hort. 27: 344, 1877	Ezz El Din; *s.n.*; 26/5/1970; Zohria Garden, Cairo
26	*Ruellia patula* Jacq., Misc. Austriac. 2: 358, 1779*	M. T. Hefnawy; *s.n.*; 23/1/1929; Gebl Elba, Egypt G. Täckholm; *s.n.*; 24/1/1929; Gebl Elba, Egypt M. Hassib; *s.n.*; 1933; Gebl Elba, Egypt V. Täckholm, M. Kassas, H. Fawzy, F. Shalaby, M. Samy, M. A. Zahran; 491; 24/1/1962; Gebl Elba, Egypt
27	*Ruellia simplex* C. Wright, Anales Ci. Méd. Habana 6: 321, 1869	Adel El-Gazzar; *s.n.*; 9/7/2015; El-Nahda square, Maadi, Cairo
28	*Ruellia tuberosa* L., Sp. Pl. 2: 635, 1753	V. Täckholm & Ibrahim El Sayed; *s.n.*; 1/6/1961; Alfred Bircher's Garden, Cairo
29	*Sanchezia oblonga* Ruiz & Pav., Fl. Peruv. 1: 7, pl. 8 f. b, 1798	Ezz El Din; *s.n.*; 13/7/1969; Zoological Garden, Giza, Egypt Mohammad El Mahdi, *s.n.*; 23/5/1969; Plant Islans, Assuan
30	*Strobilanthes petiolaris* Nees, Prodr. 11: 189, 1847	G. Täckholm; *s.n.*; 4/8/1928; Zoological Garden, Giza, Egypt
31	*Thunbergia affinis* S. Moore, J. Bot. 18: 5, 1880	M. El Mahdi; *s.n.*; 12/7/1964; Orman Garden, Giza, Egypt
32	*Thunbergia alata* Roj. ex Sims, Bot. Mag. 52: t2591, 1825	M. Kassas, M. O. Mobarak, H. A. Omar; 579; 11/12/1966; Red Sea district, Sudan A. Gazzar; *s.n.*; 23/5/1977; Banha, Qualubeya, Egypt
33	*Thunbergia erecta* T. Anders., J. Proc. Linn. Soc., Bot. 7: 18, 1864	A. Gazzar; *s.n.*; 13/7/1976; The Garden of El Zaafaran Palace, Abbassia, Cairo
34	*Thunbergia fragrans* Roxb., Pl. Coromandel 1: 47, 1796	Mohammed El Mahdi; *s.n.*; 14/4/1964; Plant Island, Assuan, Egypt
35	*Thunbergia gibsonii* S. Moore,	M. T. Hefnawy; *s.n.*;

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	Taxa	Collection data
	J. Bot. 1894: 131, 1894	1/1/1929, Zoliein Garden, Cairo
38	*Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb., Bot. Reg. 6: t. 1820	Adel Gamal, s.n., 25/5/1977, Banha, Qualiubeya, Egypt

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