Justicia thailandica, a new species of Acanthaceae from Thailand

Yi Tong¹, Yunfei Deng²,³

¹ School of Chinese Materia Medica, Guangzhou University of Chinese Medicine, Guangzhou 510006, Guangdong, China ² Key Lab of Plant Resources Conservation and Sustainable Utilization, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, Guangdong, China ³ Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences, Yezin, Nay Pyi Taw 05282, Myanmar

Corresponding author: Yunfei Deng (yfdeng@scbg.ac.cn)

Academic editor: Alan Paton | Received 8 February 2019 | Accepted 3 May 2019 | Published 6 June 2019

Citation: Tong Y, Deng Y (2019) Justicia thailandica, a new species of Acanthaceae from Thailand. PhytoKeys 124: 11–22. https://doi.org/10.3897/phytokeys.124.33745

Abstract

A new species of Justicia (Acanthaceae), J. thailandica, is described and illustrated from Thailand. The new species belongs to Justicia sect. Harnieria and is similar to J. quadrijaria and J. championii, but differs on account of the obviously densely white indumentum in the inflorescence bracts and calyx, ovate leaf blades with margin usually entire, spatulate inflorescence bracts and length ratio of calyx to mature capsule. It is assessed to be “Near threatened” (NE) according to IUCN Red List Category and Criteria. Pollen and seed morphology characters are also reported. Species of Justicia sect. Harnieria in Thailand are discussed and a key to the three recognized species is presented.

Keywords

Harnieria, Calophanoides, new taxa, taxonomy

Introduction

Justicia L. is the largest genus in the family Acanthaceae and consists of about 600 species distributed in tropical and temperate (to a lesser extent) regions of the world (Graham 1988; Hu et al. 2011; Mabberley 2017). It is characterized by the tubular...
and bilabiate corolla with stylar furrow (rugula) in the upper lip, two stamens usually with the lower anther-theca spurred at base, “Knötchenpollen” pollen grains, and 4- (rarely 2-)seeded stalked capsules (Lindau 1894; Graham 1988; Hu et al. 2011). The recent molecular evidence (Deng et al. 2016; Kiel et al. 2017) indicated that the genus *Justicia* in the broad sense is polyphyletic and might be further separated into several independent genera. At the moment, we follow the treatment of Graham (1988) who divided the genus into sixteen sections.

Sect. *Harnieria* (Solms-Laubach) Benth. is characterized by the abbreviated axillary spikes, leaf-like inflorescence bracts, fusiform capsules and tuberculate seeds (Tong et al. 2016). It comprises approximately 76 species distributed in the tropical and subtropical regions of Africa and Asia with two species extending to Australia (Barker 1986; Hedrén 1989; Tong et al. 2016).

In the course of revising *Justicia* sect. *Harnieria* from Asia, some specimens collected from Thailand and identified in herbaria as *J. quadrifaria* (Nees) T. Anderson or *J. championii* T. Anderson appear to represent an undescribed species, which differs from the latter two species by the characters of indumentum, leaves, petiole, calyx, inflorescence bracts and length ratio of calyx to mature capsule.

**Materials and methods**

The morphological comparison with related species in *Justicia* sect. *Harnieria* was based on studies of herbarium specimens and information gathered from literature. Pollen grains and seeds were taken from dried specimens (Beusekom *et al.* 3759, MO2366671) and mounted on aluminium stubs coated with gold in a sputter coater after being cleaned in water using ultrasound, and then examined using scanning electron microscopy (SEM; JSM-6360LV). The polar (P) axis and equatorial (E) diameter were measured by imaging analyzer (Smile View 2.1; JEOL Tokyo, Japan). Pollen terminology follows Erdtman (1969) and Punt *et al.* (2007). Seed terminology follows Hedrén (1989) and Rueangsawang *et al.* (2012).

**Taxonomic description**

*Justicia thailandica* Y.F.Deng & Y.Tong, sp. nov.

urn:lsid:ipni.org:names:77197854-1

Figures 1, 2

**Type.** THAILAND. Kanchanaburi Province, Kanchanaburi District, Huay Bankau, 14°55’00”N, 98°45’00”E, mixed deciduous forest on limestone, 900 m alt., 13 Nov 1971, C. F. van Beusekom, C. Phengklai, R. Geesink & B. Wongwan 3759 (holotype: MO2366671!; isotypes: BKF!, C!, K!, L!, P!).

**Diagnosis.** The new species is similar to *Justicia quadrifaria* (Nees) T. Anderson, but differs on account of the whole plant being white villous (not pubescent), leaf
*Justicia thailandica*, a new species of Acanthaceae from Thailand

**Figure 1.** *Justicia thailandica* **A** habit **B** magnifying the portion of leaf blades showing the tomentum **C** adaxil surface of inflorescence bract **D** abaxil surface of inflorescence bract **E** bract **F** bracteoles **G** calyx **H** corolla **I** dorsal view of the anther **J** frontal view of the anthers **K** pistil with nectary disc **L, M** opened capsule **N** capsule with calyx **O** seed. (Drawn by Cui Dinghan from the holotype van Beusekom et al. 3759).
blade ovate (not oval, oblong to rarely ovate) with margin usually entire (not slightly undulate), apex shortly caudate or acute (not acuminate), base cuneate (not decurrent), petiole 8−12 mm (not 5−7 mm) long, calyx densely white villous (not pubescent), inflorescence bracts spatulate and villous (not ovate to obovate and sparsely pubescent) and capsule longer than the calyx (not shorter than the calyx). It is also similar to *J. championii*, but differs by the whole plant being white villous (not pubescent), and inflorescence bracts spatulate and villous (not obovate-spatulate with apex emarginate and sparsely pubescent).

Perennial herbs, 20−35 cm tall. Stems cylindrical or sometimes quadrangular, base decumbent and usually rooting at nodes then erect, densely white villous. Leaves opposite; petiole 0.8−1.2 cm long, villous; blades ovate, oval to sometimes lanceolate, 3.5−7.5 × 1.5−4 cm, papery, apex shortly caudate or acute, margin usually entire or slightly undulate, base cuneate to shortly attenuate, both surfaces densely white villous, mid-vein and secondary veins prominent on both surfaces, secondary veins (5

Figure 2. *Justicia thailandica* A adaxial surface of inflorescence bract B abaxial surface of inflorescence bract C bract D bracteoles E stigma F pistil with nectary disc G calyx H dorsal view of anther I frontal view of anther J opened capsule K outside of capsule L inside of capsule showing retinacula M seed.
Justicia thailandica, a new species of Acanthaceae from Thailand

or) 6 on each side of mid-vein, covered with grayish white strip-like cystoliths. Spikes axillary, ca. 1 cm, usually several flowers in a cluster. Inflorescence bracts leaf-like, usually spatulate, rarely obovate, 7–8.5 × 4–5 mm, with a petiole 3–5 mm long, villous, pinnately veined with white strip-like cystoliths, apex round or sometimes obtuse, base decurrent onto petiole. Bracts and bracteoles linear, 1–1.2 mm long, white villous relatively sparsely below the middle. Calyx 7–9 mm, 5-lobed almost to base; lobes linear-lanceolate with conspicuous membranous margins, white villous, especially above the middle, apex acuminate. Corolla ca. 9 mm long, outside white villous, tube and upper lip white, lower lip white with purple spots; tube slightly longer than limb; upper lip triangular, minutely 2-lobed; lower lip 3-lobed, lobes imbricate, suborbicular. Stamens 2, attached to corolla tube, exserted; filaments ca. 2.2 cm long, basally villous; anther bithecous, thecae superposed, upper one smaller and muticous, lower one larger and with a white spur at base, anther connective pubescent. Ovary glabrous, green, fusiform with nectary flower disc bowl-shaped at base; style ca. 5 mm long, sparsely villous at base, stigma slightly 2-lobed. Capsule fusiform, 6–7 mm, glabrous, sometimes pilose at the tip. Seeds 4, compressed, ca. 1.1 × 1 mm, somewhat heart-shaped or obovate, brown or yellowish-brown, testa tuberculate.

**Etymology.** The specific epithet “thailandica” is derived from Thailand, where the new species is found.

**Phenology.** The new species was recorded in flowering from August to November and fruiting from October to December.

**Distribution and habitat.** Justicia thailandica is only known from Thailand (Fig. 4). It grows in the thickets on the limestone hills or evergreen forest at elevations of 400–900 m.

**Conservation status.** Currently, Justicia thailandica is only known from seven locations of Thailand with eight collections and the estimated extent of occurrence more than 20000 km². We speculate that it may be widespread in Thailand, but is likely to qualify for a threatened category in the near future due to its vulnerable karst habitat and human activities leading to a decline in such habitats. It is therefore assessed as “Near threatened” (NE) according to the IUCN Red List categories and criteria (IUCN 2017).

**Additional specimens examined.** THAILAND. Chiang Mai: Doi Chiang Dao, SE foothills near Ban Yang Pong Luang, 575 m alt., 30 Sep 1989, J. F. Maxwell 89-1169 (A, CAS, L). Kanchanaburi: Thong Pha Phum District, Krieng Kwia, 420 m alt., 27 Nov 1982, H. Koyama, H. Terao & T. Wongprasert 30402 (BKF, C, K). Khon Kaen: Phu Khieo Game Reserve, ca. 80 km east of Phetchabun, 16°50’00″N, 101°58’00″E, 850 m alt., 8 Nov 1984, G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagumasu & N. Nantasat T-41809 (A, BKF, TT). Loei: Nam Nao National Park, 101°23’00″–28’00″N, 16°48’00″–49’00″E, near check point of road to National Park, 280–350 m alt., 28 Oct 1984, Gen Murata, C. Phengklai, S. Mitsuta, T. Yaahara, G. Nagamasu & N. Nantasat T-51534 (TI); Pha Som Dej-Phataalern, Phu Luang NP., 1000 m alt., 14 Oct 2000, M. Norsaengsri 1075 (QBG). Nakhon Ratchasima: Pak Thong Chai District, Salika Forest, 40 km SE from Pak Thong Chai, 14°40’00″N, 102°2’00″E, 400 m alt., 25 Oct 1971, C. F. van Beusekom, Chan Wid
Pollen and seed morphology

Pollen grains of *Justicia thailandica* are 2-colporate, bilaterally symmetrical, elliptic in both polar and equatorial view, polar axis \( [P] = 33.0 \pm 1.55 \ \mu m \), equatorial diameter \( [E] = 21.6 \pm 0.85 \ \mu m \), \( P/E = 1.52 \pm 0.06 \), aperture area with 2 rows of 6–7 unequal-sized insulae, ornamentation of the insulae microreticulate with few scattered granules between muri (Fig. 3: A–B).

Seeds of *Justicia thailandica* are compressed, somewhat heart-shaped or obovate, brown or yellowish-brown, 1.1–1.2 × 1–1.1 mm, testa densely tuberculate with conspicuous rounded or oblong tubercles, ornamentation of tubercles irregular polygonal (Fig. 3: C–D).

![Figure 3. Pollen and seed morphology of *Justicia thailandica* under SEM A pollen grain in equatorial view B exine ornamentation of pollen grain C seed D seed testa.](image-url)
Discussion

Characters of pollen grains and seed testa have proved valuable in sectional delimitation in the genus *Justicia* (Graham 1988). The pollen grains of *Justicia* sect. *Harnieria* are 2-colporate, reticulate exine ornamentation and traversed by 2 rows of unequal-sized insulae (Graham 1988; Hedrén 1989; Hu et al. 2005; Rueangsawang et al. 2013; Tong et al. 2016). Seed testa of *Justicia* sect. *Harnieria* is characterized by rugulose-tuberculate with the apices of the projections pointed (Graham 1988; Hedrén 1989; Rueangsawang et al. 2012; Tong et al. 2016), i.e. “Rugulose-tuberculate” type of Graham (1988). Our observation of the pollen and seed morphology (Fig. 3: A–D) is consistent with that of *Justicia* sect. *Harnieria* (Graham 1988; Hu et al. 2005; Hedrén 1989; Rueangsawang et al. 2012, 2013; Tong et al. 2016) and due to the characters of the abbreviated axillary spikes, leaf-like inflorescence bracts, fusiform capsules, we place the new species into that section.

Only three species of *Justicia* sect. *Harnieria* have been reported from Thailand. Hosseus (1908) reported *J. quadrifaria* from Thailand based on specimen “Hosseus et al. 228”. Subsequently, Imlay (1938) added *J. quadrifaria* var. *salicifolia* (T. Anderson) Imlay based on collections “Marcan 1528 and Lakshnakara 772”. Rueangsawang (2012) and Rueangsawang et al. (2012) recorded three species based on several specimens quoted in text, viz. *J. quadrifaria*, *J. neesiana* (Nees) T. Anderson and *J. championii*. *Justicia championii* was first recorded in Thailand by Rueangsawang (2012) based on specimens (e.g. Wongprasert et al. 30402, Maxwell 73–614). However, *J. championii*, is currently known only from China and N Vietnam according to our worldwide specimen examination and is very similar to *J. quadrifaria*, but differs by the leaf shape and may be merged with the latter. After detailed comparison between the type specimen of *J. championii* and some Thai specimens (e.g. van Beusekom et al. 3759, Koyama et al. 30402, van Beusekom et al. 3362) identified in herbaria as *J. championii* or *J. quadrifaria*, we found they are obviously different and represent the new species described above. The clearest difference between *J. thailandica* and *J. championii* is that the calyx is densely white villous in *J. thailandica* (not pubescent) and inflorescence bracts are spathulate and villous in *J. thailandica* (not obovate with apex emarginate and sparsely pubescent). The leaves also tend to be different with the leaf blade ovate and white villous in *J. thailandica* (not oval, oblong to rarely ovate and pubescent), margin usually entire (not slightly undulate), apex shortly caudate or acute (not obtuse), base cuneate (not decurrent), (Fig. 5; Tab. 1). However, these leaf differences represent trends in a spectrum of variation rather than clear discontinuities.

Morphologically, *Justicia thailandica* is also similar to *J. quadrifaria*, but it can be easily distinguished from *J. quadrifaria* by the leaf blade being ovate and white villous (not oval, oblong to rarely ovate and pubescent), margin entire (not slightly undulate), petiole 8–12 mm (not 5–7 mm) long, apex shortly caudate or acute (not acuminate), base cuneate (not decurrent onto the petiole), calyx densely white villous (not pubescent), inflorescence bract spathulate and villous (not ovate to obovate and sparsely pubescent) and mature capsule longer than the calyx (not shorter than the calyx).

*Justicia quadrifaria* was recognized to be widely distributed in the tropical region of S to SE Asia from India, Indochina to Malay Archipelago and South China (Ridley
Figure 4. Distribution map of *Justicia thailandica* (black circle).

(1923; Hu et al. 2011). However, it is restricted to NE India and Bangladesh based on our worldwide specimen examination. *J. zollingeriana* (Nees) C. B. Clarke was reduced to *J. quadrifaria* or *Calophnodes quadrifaria* by some authors (Clarke 1907; Ridley 1923, Hu et al. 2011). However, it can be easily distinguished from the latter by the plant being glabrous (not pubescent in *J. quadrifaria*), calyx 4–5 mm (not 7–7.3 mm), capsule obviously more than 1.5 times longer than the calyx (not shorter than or subequal to the calyx) and leaves in each pair obviously unequal in size (not equal or subequal). *J. zollingeriana* is distributed in SE Asia from Thai Peninsular to Malay Archipelago. In Thailand, the species was first recorded as a synonym of *J. quadrifaria* by Hosseus (1908) based on specimen “Hosseus et al. 228”, and then some specimen (e.g. Kerr 7375, Garrett 316) of the species were reported under *J. quadrifaria* by Imlay (1938), while some specimen (Marcan 1528 and Lakshnakara 772) were under *J. quadrifaria* var. *salicifolia* by Imlay (1938).

*Justicia neesiana* recorded by Rueangsawang (2012) and Rueangsawang et al. (2012) is very similar to *J. multinodis* in the lanceolate leaves, however, it differs from the latter
Justicia thailandica, a new species of Acanthaceae from Thailand

Figure 5. Comparison between Justicia thailandica, J. quadrifaria, J. championii and J. salicifolia
A holotype of Justicia thailandica (Beusekom et al. 3759, MO2366671) B isotype of J. quadrifaria (Wallich 2479a, GZU000251567) C holotype of J. championii (Champion 210, K000884038) D lectotype of Justicia barapaniensis P. Soumya & Sunojk. (a new name (Soumya 2017) for J. salicifolia T. Anderson). Hooker & Thomson s.n., K000884122.
by the plant being pubescent (not nearly glabrous in later), leaf 39–47 × 5–7.5 mm (not 22–37 × 2.2–4 mm), base decurrent onto the petiole (not cuneate), lateral leaf vein 5 with veinlet not reticulate (not usually 7 with veinlet obviously reticulate), petiole 5–6 mm (not nearly sessile), axillary spikes usually with 3–5 flowers (not 2–3 flowers) and inflorescence bracts subrotund to oval, persistent (not lanceolate, caducous).

In the course of revising Thailand species of sect. Harnieria, we have confirmed there are three species in Thailand, viz. *J. zollingeriana* (Nees) C. B. Clarke, *J. multinodis* R. Benoist and a new species, *J. thailandica*, described here.

A comparison of characters between *Justicia thailandica*, *J. quadrifaria*, *J. championii* and *J. zollingeriana* is provided in Table 1. An identification key to Thai species in sect. *Harnieria* is provided below.

**Table 1.** Comparison of *Justicia thailandica*, *J. quadrifaria*, *J. championii* and *J. zollingeriana*.

|                          | *J. thailandica* | *J. quadrifaria* | *J. championii* | *J. zollingeriana* |
|--------------------------|------------------|------------------|-----------------|-------------------|
| Opposite leaf            | equal or subequal| equal or subequal| equal or subequal| obviously unequal  |
| Leaf size                | 3.5–7.5 × 1.5–4 cm| 1–2 × 5.5–6.5 cm | 1–7(–10.5) × 0.5–2(–3.5) cm | 5–10 × 2–3.5 cm |
| Leaf shape               | ovate, oval to lanceolate with margin entire    | oval, oblong to narrowly lanceolate | lancelate, oblong to narrowly lanceolate | lancelate to narrowly lanceolate |
| Leaf apex                | shortly caudate or acute | acuminate | obtuse | acuminate |
| Leaf base                | cuneate or shortly attenuate | decurrent onto the petiole | decurrent onto the petiole | cuneate |
| Petiole length           | 8–12 mm | 5–7 mm | 5–15 mm | 7–15 mm |
| Lateral leaf vein        | (5)6 | (7) | (6) | (5) |
| Indumentum               | densely white villous | pubescent | densely pubescent | glabrous |
| Inflorescence bracts     | spathulate and densely villous | ovate to obvate and sparsely pubescent | obovate-spatulate with apex emarginate and sparsely pubescent | spathulate to round and glabrous |
| Calyx                    | 7–9 mm, densely white long villous | 7–7.3 mm, pubescent | 7–9.5 mm, pubescent | 4–5 mm, glabrous |
| Calyx-capsule length ratio | 0.7–0.82 | 1.07–1.32 | 0.89–1.06 | 0.59–0.67 |
| Flowering                | Aug–Nov. | Unknown | Aug–Oct. | Jul–Sep. |
| Fruiting                 | Oct–Dec. | Unknown | Aug–Oct. | Jul–Sep. |
| Distribution             | Thailand | India and Bangladesh | South China and north Vietnam | From Thai Peninsular to Malay Archipelago |

**Identification key to Thai species in *Justicia* sect. *Harnieria***

1. Mature capsule more than 1.5 times longer than the calyx in length, leaves in each pair obviously unequal in size.......................... *Justicia zollingeriana*
   – Mature capsule short than or sub-equal to the calyx, leaves in each pair sub-equal in size .................................................................................................2

2. Inflorescence bract and calyx lobes obviously with dense long villous hairs; leaf large, ovate, 3.5–7.5 × 1.5–4 cm............................................. *J. thailandica*
   – Inflorescence bract and calyx lobes nearly glabrous or with sparsely pubescent hairs; leaf small, narrowly lanceolate, 3–7 × 0.6–0.9 cm.............. *J. multinodis*
Acknowledgements

The authors are very grateful to the curators of the following herbaria for their kind help in research facilities: A, BKF, C, CAS, K, L, MO, P, QBG and TI. Thanks are also given to Mr. Cui Dinghan (IBSC) for preparing the line drawing. This work was supported by the Natural Science Foundation of China (Grant Nos. 31700166, 31470302, 31670191) and Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences (Grant No. Y4ZK111B01).

References

Barker RM (1986) A taxonomic revision of Australian Acanthaceae. Journal of the Adelaide Botanic Gardens 9: 231–282. https://www.jstor.org/stable/23873979
Clarke CB (1907) Materials for a flora of the Malayan peninsula. Journal Asiatic Society Bengal Pt. 2, Vol. LXXIV: 681.
Deng YF, Gao CM, Xia NH, Peng H (2016) Acanthaceae, a new Chinese endemic genus segregated from Justicia (Acanthaceae). Plant Diversity 38(6): 312–321. https://doi.org/10.1016/j.pld.2016.11.010 [PubMed]
Erdtman G (1969) Handbook of palynology: an introduction to the study of pollen grains and spores. Munksgaard, 486 pp. https://doi.org/10.1002/fedr.19710810815
Graham VAW (1988) Delimitation and infra-generic classification of Justicia (Acanthaceae). Kew Bulletin 43(4): 551–624. https://doi.org/10.2307/4129957
Hedrén M (1989) Justicia sect. Harnieria (Acanthaceae) in tropical Africa. Acta Universitatis Upsaliensis Symbolae Botanicae Upsalienses 29(1): 1–141.
Hosseus CC (1908) Die aus Siam bekannten Acanthaceen. Botanische Jahrbücher für Systematik, Pflanzen Geschichte und Pflanzengeographie 41: 62–73. https://www.biodiversitylibrary.org/item/703#page/73/mode/1up
Hu CC, Tsui HP, Xi YZ, Zhang YL (2005) Pollen morphology of one genus in Lepidagathideae, two in Andrographideae and eight in Justicieae (Acanthaceae) from China. Acta Phytotaxonomica Sinica 43(2): 151–162. http://www.jse.ac.cn/EN/Y2005/V43/I2/151
Hu JQ, Deng YF, Daniel TF (2011) Justicia. In: Wu ZY, Raven PH, Hong DY (Eds) Flora of China Vol. 19. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, 449–461. http://flora.huh.harvard.edu/china/PDF/PDF19/Justicia.pdf
Imlay JB (1938) The taxonomy of the Siamese Acanthaceae. PhD Thesis, University of Aberdeen, Aberdeen.
IUCN (2017) Guidelines for Using the IUCN Red List Categories and Criteria. Version 13. Prepared by the Standards and Petitions Subcommittee of the IUCN Species Survival Commission. http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf [Accessed 8 February 2019]
Kiel CA, Daniel TF, Darbyshire I, McDade LA (2017) Unravelling relationships in the morphologically diverse and taxonomically challenging “justicioid” lineage (Acanthaceae: Justicieae). Taxon 66(3): 645–674. https://doi.org/10.12705/663.8
Lindau G (1894) Beiträge zur systematic der Acanthaceen. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 18: 36–64. https://biodiversitylibrary.org/page/203022

Mabberley DJ (2017) Mabberley's Plant-book: a portable dictionary of plants, their classification and uses. 4th edition. Cambridge University Press, Cambridge, pp 1102. https://doi.org/10.1017/9781316335581

Punt W, Hoen PP, Blackmore S, Nilsson S, Thomas AL (2007) Glossary of pollen and spore terminology. Review of Palaeobotany and Palynology 143(1–2): 1–81. https://doi.org/10.1016/j.revpalbo.2006.06.008

Ridley HN (1923) The flora of Malay Peninsula Vol. II. L. Reeve & Co., Ltd., London, 684 pp.

Rueangsawang K (2012) Systematics of the genus Justicia L. (Acanthaceae) in Thailand. PhD Thesis, Khon Kaen University, 1–155.

Rueangsawang K, Chantaranothai P, Simpson DA (2012) Contributions to the seed morphology and taxonomy of Justicia (Acanthaceae) from Thailand. Journal of Systematics and Evolution 50(2): 153–162. https://doi.org/10.1111/j.1759-6831.2012.00178.x

Rueangsawang K, Chantaranothai P, Simpson DA (2013) Pollen morphology of Justicia L. (Acanthaceae) from Thailand and its taxonomic value. Grana 52(4): 275–288. https://doi.org/10.1080/00173134.2013.819526

Soumya P, Sunojkumar P (2017) Justicia barapaniensis, a new name for Justicia salicifolia T. Anderson (Acanthaceae) Phytotaxa 332(1): 098–100. https://doi.org/10.11646/phytotaxa.332.1.12

Tong Y, Huang YS, Deng YF (2016) Justicia weihongjinii, a new species of Acanthaceae from Guangxi, China. Phytotaxa 246(2): 127–136. https://doi.org/10.11646/phytotaxa.246.2.4