

## Two new species of *Xylopia* (Annonaceae) from peninsular Thailand

DAVID M. JOHNSON<sup>1,\*</sup> & NANCY A. MURRAY<sup>1</sup>

### ABSTRACT

Two previously undescribed species of *Xylopia* are documented from southern Thailand. *Xylopia niyomdhamii* is known from a small peat swamp area in Narathiwat Province. *Xylopia microcalyx* is restricted to the limestone region extending from Chumphon south to Trang and Phatthalung Provinces, an area with many other endemic Annonaceae species. We found that *X. malayana* s.s., although previously reported, is not present in the Thai flora. A key to *X. malayana* s.s. and the Thai species of *Xylopia* is presented to summarize our taxonomic changes.

KEYWORDS: Annonaceae, South-East Asia, tree diversity, taxonomy, Magnoliales.

Accepted for publication: 26 November 2019. Published online: 6 December 2019

### INTRODUCTION

The Sundaic region of South-East Asia is a centre of diversity for *Xylopia* L., the only pantropical genus in the Annonaceae (Johnson & Murray, 2015). Species of two sections of the genus occur in the region: *Xylopia* sect. *Rugosperma* D.M.Johnson & N.A.Murray includes *X. ferruginea* (Hook.f. & Thomson) Baill., *X. fusca* Hook.f. & Thomson, and allies, and *Xylopia* sect. *Stenoxylopia* Engler & Diels includes *X. malayana* Hook.f. & Thomson and similar species (Johnson & Murray, 2015; Thomas *et al.*, 2015; Stull *et al.*, 2017). Here we recognize two previously undescribed Thai species, one from each section. Specimens from Thailand identified as *X. malayana* differ consistently from those of Peninsular Malaysia, Sumatra, and Borneo and cannot be assigned to that species.

### *Xylopia microcalyx* D.M.Johnson & N.A.Murray, sp. nov.

= *Xylopia malayana* auctt., including Gardner, Sidisunthorn, & Chayamarit, Forest Trees S. Thailand Vol. 1: 180, fig. 244. 2015, non Hook.f. & Thomson.

Species resembling *Xylopia malayana*, differing in the sparse whitish appressed pubescence of the

pedicels and sepals, sepals 1–1.2 mm long, and obovoid, obtuse to rounded monocarps that are glabrate and smooth except for multiple longitudinal ridges. Type: Thailand, Phatthalung, Si Ban Phot District, 7°40'N, 99°52'E, Khao Pu-Khao Ya National Park, headquarters, 80 m, 29 Nov. 2004 (fl, fr), Gardner & Tippayasri ST1159 (holotype **BKF**-2 sheets, isotypes **K**, **L** 0407117 [matrix barcode 1775439], 0407118 [matrix barcode 1775440]). Figs. 1L–Q, 2.

Trees up to 35 m tall; dbh up to 60 cm; trunk fluted into narrow buttresses at the base; bark tan to light orange, smooth to slightly rough. Twigs glabrous or finely pubescent, the hairs 0.1–0.2 mm long, and soon glabrate; nodes with one or occasionally two axillary branches. Leaves elliptic to oblong, chartaceous, rarely subcoriaceous, concolorous or slightly discolorous, paler abaxially, the larger blades of a specimen 8–10.8 cm long, 3.3–5 cm wide, apex broadly acuminate, the acumens 8–15 mm long, base broadly cuneate, sometimes short-decurrent on petiole, margin flat, not revolute, glabrous on both surfaces; midrib concolorous or a little darker than the blade adaxially, secondary veins weakly brochidodromous, 9–12 per side, diverging at 50–60° from midrib, these and higher-order veins slightly raised

<sup>1</sup> Department of Botany and Microbiology, Ohio Wesleyan University, Delaware, Ohio 43015 USA.

\* Corresponding author: [dmjohnso@owu.edu](mailto:dmjohnso@owu.edu)

on both surfaces; petiole 4.5–8 mm long, shallowly canaliculate, smooth, sparsely pubescent. *Inflorescences* axillary, 1–3-flowered, pedunculate, sparsely pubescent; peduncle ca 1 mm long; pedicels 1–3 per peduncle, 3.9–5.5 mm long, 0.7–1 mm thick; bracts 2, caducous or sometimes persistent, proximal bract attached between pedicel base and midpoint, distal bract attached near midpoint, 1–1.4 mm long, nearly circular; buds linear, apex acute. *Sepals* spreading at anthesis, ca ¼-connate, 1–1.2 mm long, 2.1–2.5 mm wide, coriaceous to somewhat fleshy, broadly triangular, apex acute, sparsely whitish to pale brown appressed-pubescent abaxially. *Petals* light yellow to orange yellow in vivo; outer petals spreading at anthesis, 10–19 mm long, 1.8–2.5 mm wide at base, 0.7–0.9 mm wide at midpoint, coriaceous, linear, flat adaxially, faintly ridged abaxially, apex acute, densely puberulent except for glabrous base adaxially, densely appressed-pubescent except for glabrous base abaxially; inner petals slightly spreading at anthesis, reaching at least 17.5 mm in length (apices broken off), 1.6–2 mm wide at base, 0.5–0.6 mm wide at midpoint, coriaceous, linear, ridged on distal ⅓ adaxially, ridged abaxially, apex acute, base concave and margin slightly bilobed, puberulent on both surfaces except that the base is sometimes glabrous. *Stamens* ca 45; fertile stamens 0.7–1.2 mm long, narrowly oblong, anther connective apex red in vivo, 0.2–0.3 mm long, bluntly conical to depressed-globose, overhanging anther thecae, minutely papillate, anthers 6–7-locellate, filament 0.2–0.3 mm long; some of outermost stamens with reduced numbers of anther locelli but none appear to be truly staminodial; inner staminodes 1.2–1.3 mm long, oblong, apex obtuse; staminal cone 1.2–1.4 mm in diameter, 0.4–0.6 mm high, concealing all but the apices of the ovaries, rim lacinate to nearly even. *Carpels* 2–6 (ex Gardner *et al.*, 2015); ovaries much shorter than stigmas, pubescent, stigmas loosely connivent, 2.6–3.2 mm long, filiform, with a few scattered hairs or glabrous. *Fruit* of up to 3 monocarps borne on a pedicel 11–13.5 mm long, 2–3 mm thick, glabrate; torus 4.5–6 mm in diameter, 3.5–5.5 mm high, pyramidal. *Monocarps* with green to reddish green exterior and scarlet endocarp in vivo, 2.4–4.1 cm long, 1.1–1.6 cm wide, ca 1.3 cm thick, obovoid, not torulose, apex obtuse to rounded, base contracted into a stipe 3–5.5 mm long, 3–4 mm thick, faintly wrinkled, verrucose, often marked with multiple longitudinal ridges, glabrate; pericarp 0.6–1.2 mm

thick. *Seeds* up to 8 per monocarp, in two rows, oblique to perpendicular to long axis, ca 11.6 mm long, 7.3 mm wide, 6.2 mm thick, ellipsoid, wedge-shaped in cross-section, brown, smooth, slightly shiny, perichalazal ring not visible; sarcotesta pale gray (ex Gardner *et al.*, 2015) in vivo; aril a flat white fleshy ring encircling the micropyle.

Thailand.—PENINSULAR: Chumphon [Phato District, 9°51'N, 98°48'E, Nam Tok Ngao National Park, trail along ridge west of Klong Yae Substation, 250 m, 13 Dec. 2005 (fl., fr.), Gardner ST2082 (BKF, L 0408636)]; Nakhon Si Thammarat [Ta Samet, 20 Jan. 1928 (fl.), Kerr 14296 (BK); Tha Sala District, 8°43'N, 99°40'E, Khao Luang National Park, trail to Krung Ching Waterfall, 170 m, 27 Feb. 2006 (young fr.), Gardner & Sidsunthorn ST2388 (BKF, L 0408596)]; Phatthalung [Khao Pu-Khao Ya National Park, 18 Mar. 2003 (fl., fr.), Johnson & Chalermglin 2053 (OWU, spirit collection only)]; Trang [Ka-chawng, 100 m, 29 Sept. 1949 (fl.), Din 323 (BKF herb. No 7623); Khao Chong, 4 Dec. 1969 (fl., fr.), Phusomsaeng & Pinnin 325 (BKF No. 52081, K, L-0196249); Khao Chong Botanical Garden 20 km W of Trang, 7°32'N, 99°46'E, 21 June 1984 (st.), Rogstad 980 (A); Khao Chong, 24 Nov. 1969 (fr.), Sangkhachand 2189 (BK)].

Distribution.—Endemic to the limestone region of peninsular Thailand south of the Kra Isthmus, an area in which a number of other endemic species of Annonaceae occur (Damthongdee *et al.* 2019).

Ecology.—Lowland moist forest, at elevations from 80 to 250 meters above sea level. Flowering: January, March, June, November, December; fruiting: January, March, November, December.

Etymology.—Named for the small sepals that are a distinctive feature of the species.

Vernacular.—Krai (กระยาบ)(Din 323).

Notes.—*Xylopi microcalyx* is described and illustrated in Gardner *et al.* (2015), where it is identified as *X. malayana*. The accession labeled as *X. malayana* in the molecular phylogenetic analysis of Stull *et al.* (2017) is also this species. In its medium-sized elliptic leaf blades, relatively small flowers, and short broad fruits, the new species resembles *X. malayana* but, as noted in the diagnosis, *X. microcalyx* differs consistently in characteristics of both the flowers and fruits. In addition, *X. microcalyx* is often a larger tree than *X. malayana*, reaching a

height of 35 m, while *X. malayana* rarely reaches 20 m. Populations of the two species are geographically disjunct, as *X. malayana* extends no further north than central Kedah and southern Kelantan states in peninsular Malaysia; a report of *X. malayana* from sites in southern Narathiwat Province (Kitamura *et al.*, 2011) has not been verified.

***Xylopia niyomdhamii* D.M. Johnson & N.A. Murray, sp. nov.**

Species resembling *X. fusca* in the strongly connate sepals, but with the leaf blades short-acuminate and only sparsely covered with whitish hairs abaxially, the petioles wrinkled longitudinally, and outer petals 10.7–17 mm long and strongly keeled abaxially, even in bud. Type: Thailand, Narathiwat, Kok Dan peat swamp forest, near sea level, 28 Feb. 1984 (fl.), *Niyomdham 804* (holotype **BKF**; isotypes **AAU**, **K**, **L**-0196158). Fig. 1A–G

Tree up to 30 m tall. *Twigs* finely pubescent, the hairs ca 0.1 mm long, at length glabrate; nodes with one or occasionally two axillary branches. *Leaves* broadly elliptic to oblong, chartaceous to subcoriaceous, concolorous, the larger blades of a specimen 6.4–7.2 cm long, 3.1–5 cm wide, apex acuminate, the acumen 5–7 mm long, base broadly cuneate to rounded and short-decurrent on petiole, margin flat, not revolute, glabrous adaxially, glabrate or with a few appressed hairs persisting along the midrib abaxially; midrib concolorous with blade adaxially, secondary veins weakly brochidodromous, 7–9 per side, diverging at 45–60° from midrib, these and higher-order veins slightly raised on both surfaces; petiole 5.5–8 mm long, shallowly canaliculate, longitudinally wrinkled, sparsely pubescent. *Inflorescences* axillary, 1–3-flowered, short-pedunculate, finely pale brown erect-pubescent; peduncles 1–2 mm long; pedicels somewhat flattened and often obliquely bent near midpoint, 3–6 mm long, 1–1.4 mm thick; bracts 2, proximal bract attached near midpoint of pedicel and often persistent, distal bract subtending sepals and often caducous, 1.4–2 mm long, broadly ovate, apex rounded; buds lanceolate to narrowly oblong, apex obtuse. *Sepals* erect at anthesis, ½–¾-connate, 2.5–3.2 mm long, 2.3–3 mm wide, coriaceous, ovate, apex broadly acute to rounded, pale brown pubescent and warty abaxially. *Petals* light yellow in vivo; outer petals probably slightly spreading at anthesis, 10.7–17 mm long, 2.4–3 mm

wide at base, 1.5–1.7 mm wide at midpoint, coriaceous, linear-lanceolate, longitudinally furrowed adaxially, strongly keeled abaxially, apex obtuse, densely puberulent adaxially, densely appressed-pubescent abaxially; inner petals with position at anthesis not determinable, 11.6–11.8 mm long, 1.6–2.2 mm wide at base, 1.1–1.3 mm wide at midpoint, coriaceous, linear-lanceolate, keeled except for the concave base adaxially, keeled abaxially, apex obtuse, base with an undifferentiated margin, densely puberulent on both surfaces except for the sparsely puberulent base. *Stamens* ca 25–35; fertile stamens 2.1–2.4 mm long, linear, anther connective apex 0.3–0.4 mm long, bluntly conical, scarcely overhanging anther thecae, papillate, anthers 8–11-locellate, filament 0.3–0.4 mm long; outer staminodes 2.2–2.3 mm long, narrowly elliptic to oblong, apex obtuse; inner staminodes absent; staminal cone 1.6–1.7 mm in diameter, 0.5–0.6 mm high, a low ring covering only the bases of the ovaries, rim slightly laciniate. *Carpels* 3–5; ovaries 1.1–1.4 mm long, oblong, pubescent, stigmas loosely connivent, 1.5–1.6 mm long, narrowly clavate, glabrous. *Pedicel* and torus of fruit unknown. *Monocarps* reddish brown in vivo, 3.5–5 cm long, 1.3–1.5 cm wide, thickness not determinable, oblong, not torulose, apex obtuse to rounded, base contracted into a stipe ca 5 mm long, 3–6 mm thick, smooth or faintly wrinkled, glabrate; pericarp 1.8–2 mm thick. *Seeds* up to ca 6 per monocarp, probably in a single irregular row, oblique to long axis, ca 8.3 mm long, 6.6 mm wide, 6.2 mm thick, broadly ellipsoid, nearly circular in cross-section, dark brown, strongly rugose, slightly shiny, perichalazal ring not evident; presence of sarcotesta unknown; aril absent.

Thailand.— PENINSULAR: Narathiwat [Tak Bai, Phu Kok Dan, near sea level, 13 Mar. 1985 (fr.), *Niyomdham 847* (**AAU**, **BKF**, **K**)].

Distribution.— Endemic to Narathiwat Province, Thailand.

Ecology.— Coastal peat swamp forest, near sea level. Flowering: February; fruiting: March.

Etymology.— *Xylopia niyomdhamii* is named in recognition of Chawalit Niyomdham, who first documented the peat swamp flora of Narathiwat Province (Niyomdham, 1986) and collected the only known material of the species.

Vernacular.— Suelee yae baa nae (*Niyomdham 804*), sue lee yae ya ka (*Niyomdham 847*).

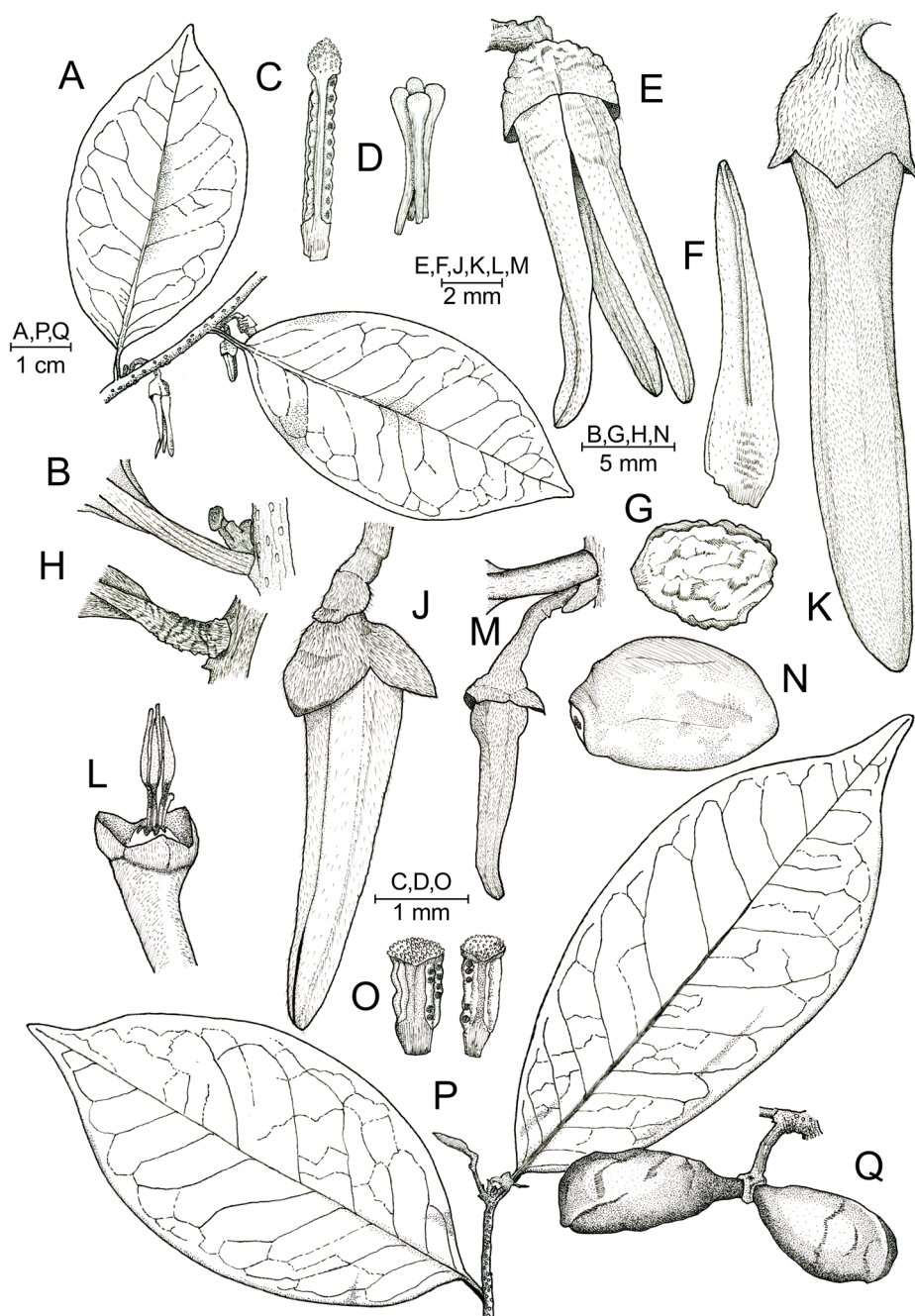


Figure 1. *Xylopia niyomdhamii* and *X. microcalyx*, with details of *X. malayana* and *X. fusca* shown for comparison. A–G, *Xylopia niyomdhamii*. A. Habit. B. Petiole, abaxial view, showing longitudinal wrinkles. C. Stamen, abaxial view. D. Group of detached stigmas from a single flower. E. Opening flower, side view. F. Outer petal, abaxial view showing keel. G. Seed, side view. H, K. *Xylopia fusca*. H. Petiole, abaxial view, showing transverse wrinkles. K. Flower bud, side view. J. *Xylopia malayana*, flower bud in side view. L–Q, *Xylopia microcalyx*. L. Receptacle, showing persistent sepals and stigmas. M. Flower bud, side view. N. Seed, side view. O. Stamens, abaxial view. P. Habit. Q. Fruit, side view. A, B, C, D, E, and F based on Niyomdham 804 (AAU), G based on Niyomdham 847 (AAU), H based on Niyomdham 1709 (NY), J based on Maingay distrib. no. 81 (BM-000511033), K based on Niyomdham 635 (US), L, N, and O based on Johnson & Chalermglin 2053 (OWU, spirit collection), M, P, and Q based on Gardner *et al.* 1159 (L). Illustration by D.M. Johnson.



Notes. —The two specimens identified here as *Xylopia niyomdhamii* were recorded as *X. malayana* and *X. fusca* in Niyomdham (1986). The elliptic acuminate leaves and relatively small flowers of the new species are similar to those of *X. malayana*, but overall the new species is more similar to *X. fusca*. *Xylopia niyomdhamii* and *X. fusca* share strongly connate sepals, as well as relatively long stamens with the anther connective apex not strongly overhanging the anther thecae, rudimentary staminal cones, and rugose seed coats characteristic of *Xylopia* sect. *Rugosperma* (Stull *et al.*, 2017). The leaves of *X. niyomdhamii*, however, differ from those of *X. fusca* in being short-acuminate rather than obtuse

to rounded, have petioles that are longitudinally rather than transversely wrinkled, and are glabrate abaxially rather than covered with appressed golden hairs. In addition, both the outer and inner petals of *X. niyomdhamii* are shorter than those of *X. fusca*, as well as strongly keeled on the abaxial surface, a feature visible even in small buds. Niyomdham (1986) also noted that *Niyomdham 804*, designated here as the type of *X. niyomdhamii*, lacked the stilt roots characteristic of *X. fusca*, and instead had buttresses. There is a remote possibility that this plant is a hybrid between *X. fusca* and another *Xylopia* species, but *X. fusca* is the only other *Xylopia* species reported for the Narathiwat peat swamp forests (Niyomdham, 1986).



Figure 2. *Xylopia microcalyx*. Freshly fallen flowers, petals, and undehisced and dehisced monocarps. Khao Pu-Khao Ya National Park. Photograph by D.M. Johnson.

#### KEY TO *XYLOPIA MALAYANA* S.S. AND THE THAI SPECIES OF *XYLOPIA*

1. Leaf blades erect-pubescent abaxially, base rounded, subcordate, or truncate, rarely broadly cuneate, not decurrent on petiole
  2. Larger leaf blades of a specimen 12–15.5 cm long; petals 27–60 mm long; monocarps linear, 6–11.5 cm long; aril absent ***X. ferruginea***
  2. Larger leaf blades of a specimen 5.5–9.5 cm long; petals 11–28 mm long; monocarps lanceolate to oblong, 4.4–5.2 cm long; aril forming a corky ring around the micropyle
    3. Outer petals 11–14 mm long, pale yellow, flushed with red or purple at the base; monocarps nearly terete in cross-section; plants of dry dipterocarp forest or mixed deciduous forest ***X. vielana***
    3. Outer petals (16–) 20–28 mm long, uniformly pale yellow; monocarps flattened in cross section; plants of lowland evergreen forest ***X. platycarpa***
1. Leaf blades glabrous or appressed-pubescent abaxially, base cuneate to broadly cuneate, rarely rounded, sometimes short-decurrent on the petiole
  4. Leaf blades densely appressed-pubescent abaxially, the hairs usually golden on young leaves; flower pedicels 8–10 mm long ***X. fusca***
  4. Leaf blades glabrous to sparsely appressed-pubescent abaxially, the hairs whitish to pale brown, but never golden, on young leaves; flower pedicels 1.5–5.5 mm long
    5. Flower buds ovoid; carpel 1 ***X. subdehiscens***
    5. Flower buds lanceolate to linear; carpels 2 or more
      6. Outer petals keeled abaxially; uppermost pedicel bract subtending the sepals ***X. niyomdhamii***
      6. Outer petals flat abaxially; uppermost pedicel bract attached at pedicel midpoint

7. Buds and outer petals obtuse; leaf blade obtuse **X. pierrei**  
 7. Buds and outer petals acute; leaf blade acuminate  
 8. Sepals 1–1.2 mm long, sparsely whitish to pale brown appressed-pubescent; monocarps obovoid, longitudinally ridged but otherwise smooth, glabrate **X. microcalyx**  
 8. Sepals 3–4 mm long, densely rusty-pubescent; monocarps oblong, obliquely wrinkled, sparsely rusty-pubescent to glabrate **X. malayana**

## ACKNOWLEDGEMENTS

We thank the Fulbright Foundation, the TEW Presidential Discretionary Fund of Ohio Wesleyan University, and the Carlsberg Foundation for funding to support field and herbarium work in Thailand in 2003, 2017, and 2018. The curators of A, AAU, BK, BKF, BM, K, L, NY, OWU, and US made specimens and specimen images available for study. For field and herbarium assistance we thank Henrik Balslev, Piya Chalermglin, Kongkanda Chayamarit, and Simon Gardner. Richard Saunders and an anonymous reviewer provided helpful suggestions for improvement of the manuscript. Douglas Thompson, Ohio Wesleyan University, prepared the final images for publication.

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