

TAXONOMY OF *XYLOPIA BARBATA* (ANNONACEAE) AND RELATED SPECIES FROM THE AMAZON/ORINOCO REGION

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Xylopia, a pantropical genus of Annonaceae characterized by axillary inflorescences, long narrow petals, and dehiscent fruits, is well-represented in the Neotropics, where about 50 species are known to occur (Fries 1959). One of the more distinctive Neotropical species is *X. barbata* Hoffmanns. ex Martius, named for the shaggy brown or brownish yellow hairs that clothe the twigs and lower surfaces of the leaves; it also has especially long and narrow flowers. Fries (1931), in describing *X. conjungens*, noted the similarity of its leaf and flower pubescence, floral structure, and leaf venation to those of *X. barbata*, but observed that the leaf shape was similar to that of *X. frutescens* Aublet. Many recent specimens with this combination of distinctive pubescence and elongate flowers are either intermediate between *X. barbata* and *X. conjungens* in leaf shape or fit in neither taxon.

As a result of a herbarium study, we place *X. conjungens* in synonymy under *X. barbata*, and recognize two new species, *X. rigidiflora* and *X. orinocensis*. The long hairs and narrow petals of these three species are a unique combination of character states among Neotropical xylopias, suggesting that these species form a natural group. The pollen tetrads are of a common type in *Xylopia* (Kathleen Peterson, pers. comm.), and the seeds bear the bilobed aril that characterizes the largely Neotropical Section *Xylopia*. All three species are restricted to sandy habitats, perhaps indicating that the ancestor of this group was a habitat specialist.

Fries (1959) did not indicate the relationship of *X. barbata* or *X. conjungens* to other species, choosing instead to group them artificially, by means of a key, with species that share narrow petals, free sepals, and elliptic to oblong-elliptic leaf blades. Intrageneric relationships of the *Xylopia barbata* group remain unclear.

KEY TO THE SPECIES OF THE *XYLOPIA BARBATA* GROUP

1. Leaves 2.3–3.8 cm wide, concolored or only slightly darker adaxially than abaxially; leaf venation with loops outside the closed arches of the secondary veins (“festooned-brochidodromous”); outer petals 2.7–3.2 mm wide at midpoint, fleshy and somewhat woody. *X. rigidiflora*.
1. Leaves 0.8–2.3 cm wide, discolored, distinctly darker adaxially than abaxially; leaf venation without regular loops adorning the secondary vein arches; outer petals 1.3–1.9 mm wide at midpoint, coriaceous to fleshy.
 2. Lamina base cuneate to attenuate and minutely decurrent on petiole; corolla orange, pubescence not brown. *X. orinocensis*.
 2. Lamina base cuneate to broadly cuneate but not decurrent on petiole; corolla yellow, with brown pubescence. *X. barbata*.

Xylopia barbata Hoffmannsegg ex Martius, Fl. bras. 13(1): 40. 1841. *Xylopicrum barbatum* (Hoffmannsegg ex Martius) Kuntze, Revis. gen. pl. 1: 8. 1891.—TYPE: BRAZIL. [Pará:] “In ripa fluvii Tocantins, locis sabulosis virgultosis, ad Cametá,” Sieber [353] (lectotype, here designated: M, photos: F! MO! NY!; isoelectotype: BR).

Xylopia conjungens Fries, Acta Horti Berg. 10: 333. 1931.—TYPE: PERU. Loreto: Mishuyacu, 100 m, near Iquitos, Feb–Mar 1930, Klug 970 (holotype: B; isotypes: F! NY!). Fig. 1F–H.

Shrub 2.5 m tall to medium-sized tree 25 m tall, DBH 6–41 cm; bark pale red, wrinkled (ex Benko-Iseppon). Leaf-bearing twigs 0.4–2.5 mm in diameter, tomentose-velutinous to glabrate, the 1 mm-long hairs golden to straw-colored, dotted with light brown circular lenticels. Lamina of larger leaves 3.2–7.3 cm long, 1–2.3 cm wide, subcoriaceous, elliptic or oblong, paler abaxially, cuneate to broadly cuneate and not decurrent on petiole at the base, acuminate, acute, obtuse, or retuse at the apex, the acumen, if present, 1.5–14 mm long, glabrous adaxially, sparsely pubescent to puberulent abaxially, midrib tomentose abaxially, margins puberulent to tomentose; midrib impressed to plane adaxially, raised and semiterete abaxially; secondary veins 6–12 per side, departing at 45–75° from midrib, indistinctly brochidodromous, anastomosing (1.2–) 1.6–3.9 mm from margin; secondary and higher-order veins indistinct, raised adaxially, slightly raised abaxially. Petiole 0.6–2.5 mm long, 0.4–1.4 mm wide, terete, tomentose-velutinous to puberulent. Inflorescences 1-flowered, occasionally 2–3-flowered from a very short peduncle, axillary; pedicels 1.4–3.5 mm long, 0.5–1.4 mm thick, bracts 2–3, occasionally 4, 1.9–3.8 mm long, ovate, clasping, tomentose-velutinous to glabrate. Buds linear-lanceolate, acute. Calyx 3.2–5.8 mm long, 3.8–7.4 mm in diameter, cup-shaped, coriaceous, sparsely tomentose-velutinous; lobes 1.8–3.5 mm long, 1.8–3.7 mm wide, apiculate at apex. Corolla yellow, brown- or maroon-pubescent, coriaceous to fleshy, tomentose to thickly velutinous; outer petals spreading slightly at anthesis, 1.4–2.2 cm long, 2.2–3.1 mm wide at base, 1.3–2.2 mm wide at midpoint, linear, acute at apex, expanded and concave at base, glabrous adaxially, finely appressed pubescent abaxially; inner petals 1.3–1.9 cm long, 1.8–2.6 mm wide at base, 0.6–0.8 mm wide at midpoint, linear-filiform, acute at apex, expanded and concave at base, rhomboidal in cross section, puberulent. Stamens 50–80, 1–1.2 mm long, narrowly oblong, glabrous; anthers septate at anthesis; apex of connective 0.2 mm long, truncate or slightly hemispheric; filament 0.3–0.4 mm long; innermost stamens staminodial, appressed to the stigma bases. Carpels 4–5, seated in the concavity of the torus with only stigmas emergent; ovaries 1.1–1.2 mm long, long-sericeous; ovules 2–3 (–6), attached laterally; stigmas 4.2–5.6 mm long, coherent, filiform, pubescent. Torus 1.8–2.5 mm in diameter, conical, deeply concave in center, glabrous. Fruit of 2–4 monocarps borne on a pedicel 4.9–5.9 mm long, 1.4–1.7 mm thick, tomentose to glabrate, with sepals persistent; torus of fruit 3.2–4.2 mm in diameter; monocarps dehiscent, yellow or green with a red interior, 2.2–4 cm long, 4.6–7.5 mm wide, oblong, falcate to semi-torulose, surface verrucose and with the venation of the pericarp somewhat raised, puberulent to glabrate; stipe 4–5.5 mm long, 1.8–2 mm wide at midpoint; apex acute, with an oblique mucro 1.2–3 mm long; pericarp ca. 1 mm thick. Seeds 3–6, at 75° to long axis of monocarp, 9.8 mm long, 4.2 mm wide, 3.7 mm thick, ellipsoid, elliptic in cross section, black or dark brown, smooth and somewhat shining; aril white, bilobed, 2 mm long, 3.8 mm wide.

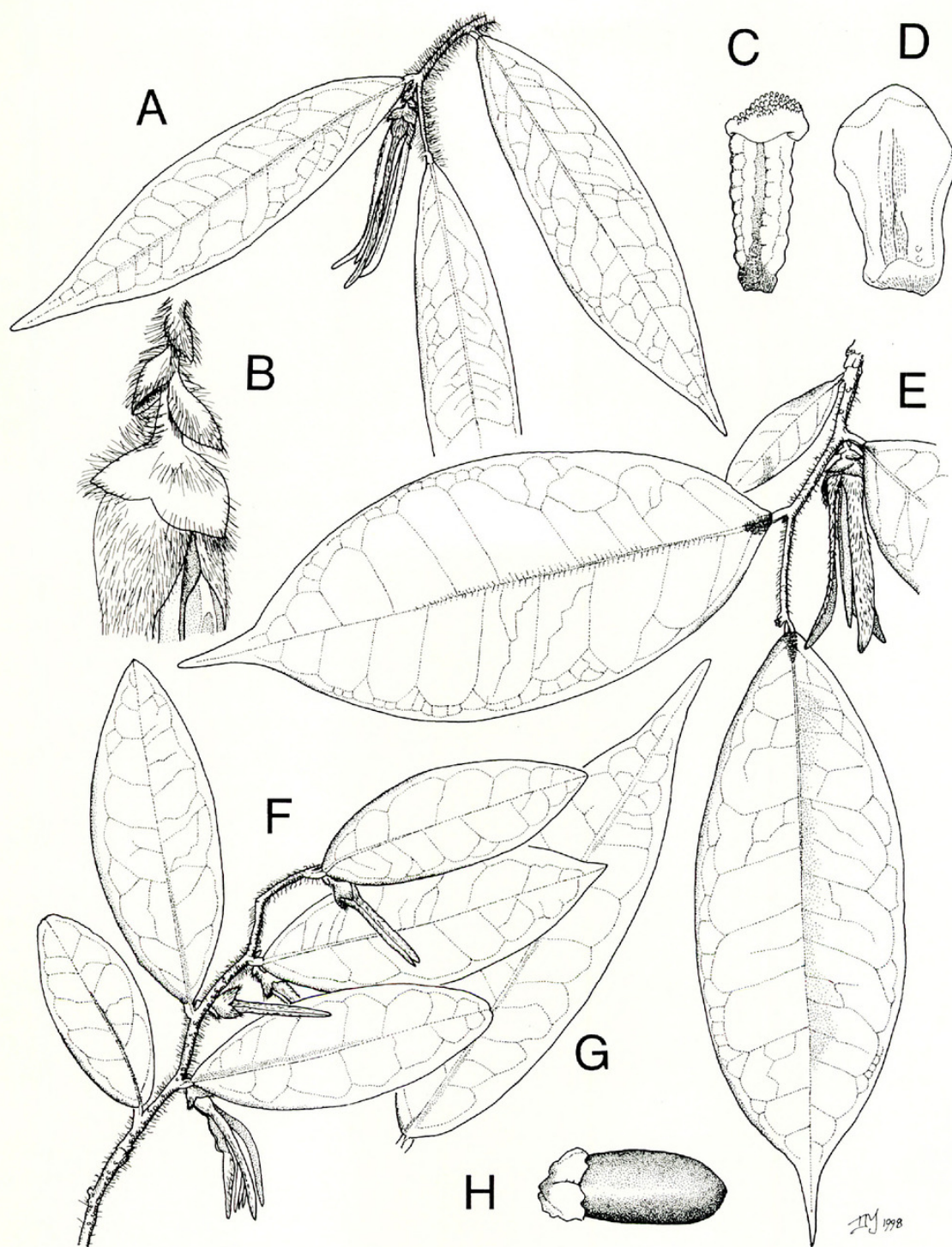


FIG. 1. *Xylopia barbata*, *X. rigidiflora*, and *X. orinocensis*. A–B, *X. orinocensis*. A. Habit, $\times 1$. B. Close-up of pedicel, calyx, and petal bases, $\times 5$. C–E, *X. rigidiflora*. C. Stamen, $\times 20$. D. Staminode, $\times 20$. E. Habit, $\times 1$. F–H, *X. barbata*. F. Habit, $\times 1$. G. Leaf of Peruvian specimen, $\times 1$. H. Seed, lateral view, $\times 2.5$. Based on: A–B, Yanez 172 (US); C–E, Silva 221 (INPA, NY); F, Benko-Iseppon 373 (OWU); G, Vásquez & Jaramillo 15259 (MO); H, Prance et al. 5433 (US).

ADDITIONAL SPECIMENS EXAMINED. **Brazil.** AMAZONAS: Rio Urutú [Urubú?—see note below], Fróes 25487 (NY); Manaus, margem do Ig. dos Francêses, Mello 3177 (U); Enseada Grande, Ponta Negra, margem do rio, Rodrigues & Lima 2205 (F); Manáos, Rio Negro, Ule 5428 (K).—PARÁ: Mpio. de Santarém, Vila de Alter do Chão, $2^{\circ}31'S$, $55^{\circ}00'W$, Albernaz 148 (K, NY, U); Mpio. Alter do Chão, 69 km a sul de Santarém, em “ilha” do Rio Tapajós, cerca de 200 m distante da principal rua do Mpio. Alter do Chão, Benko-Iseppon 373 (OWU, SPF, U); Mpio. de Santarém, Vila de Alter do

Chão, 2°31'S, 55°00'W, *Ferreira 054* (K, NY, U); Santarém, *Kuhlmann 1736* (NY, U); Sta. Terezinha, margem direita do Rio Tapajós, *Maciel & Cordeiro 137* (NY, U); in siccis arenosis temporariis pluviali inundatis Santarém, *Riedel 1566* (NY, US); in vicinibus Santarém, Nov 1849, *Spruce 388* (K, NY, fragments ex G and B at F; only the sheet from Herb. Benth. at K bears date and collection number); Lower Amazons, campos near Santarém, *Traill 8* (K-2 sheets, one dated 21 Dec 1873, the other 25 Dec 1873); Santarém, Belterra, as proximidades do igarapé Iruçanga, entre Pindobal e Porto Novo, *Vilhena et al. 162* (NY, U).—RONDÔNIA: vicinity of Mutumparaná, *Prance et al. 5433* (K, MO, NY, U, US); margin of Mutumparaná airstrip, *Prance et al. 8851* (OWU). **Peru.** LORETO: Maynas, Mishana, 3°55'S, 73°35'W, *Vásquez et al. 4048* (MO); Iquitos, Allpahuayo, Estación Experimental del Instituto de Investigaciones de la Amazonía Peruana, 4°10'S, 73°30'W, *Vásquez & Jaramillo 15259* (MO), 15268 (MO, U).

Flowering specimens have been collected from October through March, and one Peruvian specimen was collected with buds in May. Fruits have been collected in July and November. *Xylopia barbata* is known from Loreto Department in Peru, and from the Brazilian states of Amazonas, Pará, and Rondônia (Fig. 2), occurring at elevations of 100–180 meters. The usual habitats of *X. barbata* are *praia arenosa*, *restinga*, and savanna forest, i.e., sandy open habitats along rivers, which are widely distributed within the Amazon basin and contain numerous endemic species (Pires & Prance 1985).

The type of *X. conjungens*, as well as subsequent collections from Loreto, Peru, differ from most material of *X. barbata* in having distinctly acuminate leaf apices and golden spreading pubescence on the twigs and abaxial midribs of leaves. These specimens were all collected from trees 20–25 m tall. In contrast, plants of *X. barbata* from the vicinity of Santarém are typically shrubs or small trees 2.5–10 m tall, with acute to obtuse or even retuse leaf apices and brown or brownish yellow pubescence. These characters seem to vary independently, however: the two Prance specimens from Rondônia have golden hairs, but the leaves are acute to obtuse, and the trees were 10–11 m tall; the Fróes specimen from Amazonas has acute leaf apices and is from a tree 12 m tall, but its hairs are not conspicuously golden. We have therefore concluded that all are best treated as a single species for which there seems to be clinal variation in size, shape of the leaf apex, and color of the pubescence.

The specimen collected by Fróes from the “Rio Urutú” in the state of Amazonas is, in fact, probably from the Rio Urubú, a river that enters the Amazon just downstream from Manaus: Fróes collected his number 25355 from the Urubú on 22 September 1949, just 13 days earlier.

Martius (1841) based *Xylopia barbata* on specimens collected by Sieber in the vicinity of Cametá and by Riedel at Santarém, and used Hoffmannsegg's unpublished binomial. Hoffmannsegg was also the source of the Sieber collections seen by Martius (Lasègue 1845), and the Sieber syntype is accordingly chosen as lectotype. Fries (1930) cited a Sieber specimen without collection number at BR; the specimen in the photograph distributed by the Field Museum is attributed to the Munich Herbarium and shows a collection tag bearing the number “353.”

Xylopia rigidiflora K. Bagstad & D. M. Johnson, sp. nov.—TYPE: BRAZIL. Amazonas: Mpio. Barcelos, Rio Jauari, 00°42'N, 63°22'W, abaixo do entroncamento com igarapé Pretinho, 2 Jul 1985 (fl), *Silva 221* (holotype: INPA!; isotypes: NY! U!). Fig. 1C–E.

Species *X. barbatae* et *X. orinocensi* similis, ab ambabus laminis foliorum concoloribus vel leviter discoloribus 2.3–3.8 mm latis, arcubus adjectis praeter arcus venarum secundariarum, et petalis exterioribus carnosolignosis medio 2.7–3.2 mm latis differt.

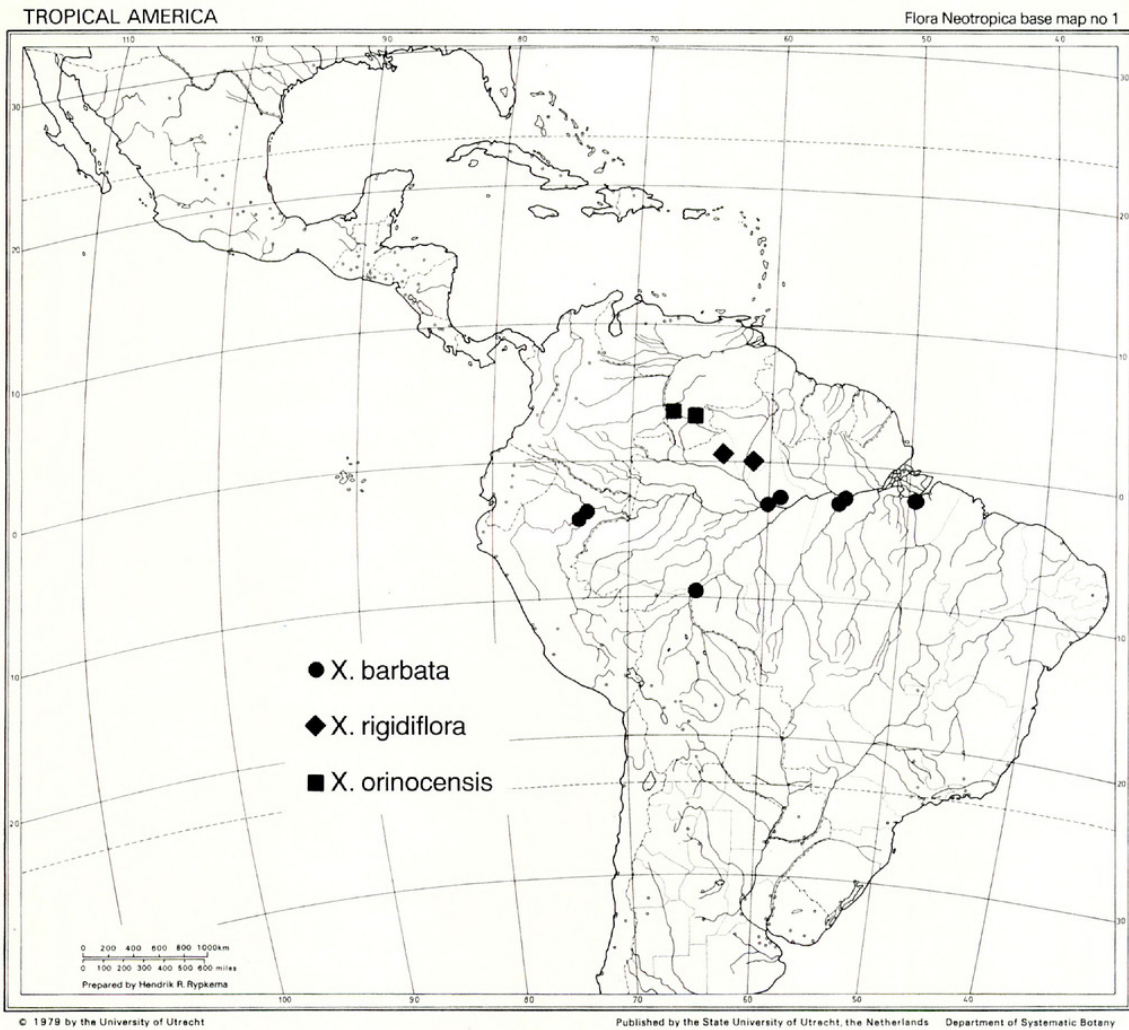


FIG. 2. Distribution of *Xylopia barbata*, *X. rigidiflora*, and *X. orinocensis* in South America.

Shrub 2–4 m tall. Leaf-bearing twigs 0.6–2.1 mm in diameter, tomentose-velutinous or puberulent to glabrate, with grayish hairs ca. 1 mm long persistent on younger twigs, marked with occasional circular cream-colored lenticels. Lamina of larger leaves 5.3–9.1 cm long, 2.3–3.8 cm wide, subcoriaceous to coriaceous, elliptic or occasionally oblong, concolored or slightly darker adaxially than abaxially, cuneate but not decurrent on petiole at base, cuspidate to short-acuminate at apex, the acumen 5–15 mm long, glabrous adaxially, puberulent with a tomentose midrib abaxially, margins puberulent to sparsely pubescent; midrib impressed to plane adaxially, raised and semiterete abaxially; secondary veins 9–12 per side, departing at 55–80° from midrib, festooned-brochidodromous, anastomosing 2.5–8.9 mm from margin; secondary and higher-order veins indistinct, raised adaxially, slightly raised abaxially. Petiole 1.2–2.0 mm long, 0.6–1.5 mm wide, terete, tomentose or puberulent. Inflorescences 1-flowered, axillary; pedicel 2.4–3.0 mm long, 0.8 mm thick, tomentose; bracts 2–3, 3–3.5 mm long, clasping, ovate, tomentose. Buds linear-lanceolate, obtuse. Calyx 4.3–6.5 mm long, 5.6–8.3 mm in diameter, cup-shaped, coriaceous, tomentose to puberulent; lobes 2.6–4.1 mm long, 2.7–3.6 mm wide, apiculate at apex. Corolla yellow, fleshy and somewhat woody; outer petals spreading slightly at anthesis, 1.5–2.1 cm long, 3.9–4.6 mm wide at base, 2.7–3.2 mm wide and 1.1 mm thick at midpoint, linear-lanceolate, acute and slightly trigonous at apex, expanded and slightly concave at base, puberulent adaxially,

sericeous and slightly keeled abaxially; inner petals 1.8–1.9 cm long, 2.8–3 mm wide at base, 1.6–1.8 mm wide at midpoint, linear, acute at apex, expanded and concave at base, rhomboidal in cross section, puberulent on keel adaxially, puberulent abaxially. Stamens 1–1.2 mm long, narrowly oblong, glabrous; anthers septate at anthesis; apex of connective 0.15–0.3 mm long, truncate or slightly hemispheric, papillate; filament 0.2–0.3 mm long; innermost stamens staminodial, appressed to stigma bases, flattened, oblong or quadrate. Carpels 9, seated in the concavity of the torus with stigmas and upper half of ovaries emergent; ovaries 2 mm long, lanceolate, long-sericeous; ovules 3; stigmas coherent, filiform, pubescent. Torus 3.6 mm in diameter, tomentose around circumference, center portion 1.9 mm in diameter, 0.9 mm high, conical, deeply concave. Fruits and seeds unknown.

ADDITIONAL SPECIMENS EXAMINED. **Brazil.** RORAIMA: Mpio. São Luiz do Anauá, entre kms 350 e 355 da Estrada Manaus–Caracará (BR-174), próximo ao Equador, 0°00', 60°45'W, 21 Aug 1987, *Cid Ferreira 9064* (OWU, U).

Both collections are of flowering material, one from July and the other from August. Both were collected from lowland campina habitat on sandy soil in northern Brazil near the frontier with Venezuela (Fig. 2). This area is inhabited by a number of other endemic woody species: *Pagamea aracaensis* (Rubiaceae), *Couepia amaralae* and *Licania nelsonii* (Chrysobalanaceae), *Pithecellobium prancei* (Mimosaceae), *Ternstroemia campinicola* (Ternstroemiaceae), and *Caraipa longisepala* (Clusiaceae) (Prance & Johnson 1992).

The petals of *X. rigidiflora* are, as its specific epithet suggests, thicker and stiffer than those of the other two species treated here; the outer petals are also wider. The leaf is markedly wider, with formation of strong loops outside the arches of the secondary veins; in the type specimen the leaves are strongly cuspidate. The leaves are concolored or only slightly darker adaxially than abaxially, whereas the leaves of the other two species are distinctly discolored.

Xylopia orinocensis K. Bagstad & D. M. Johnson, sp. nov.—TYPE: VENEZUELA, Amazonas: Dpto. Atabapo, Alto Río Orinoco, 25 km SE de la Esmeralda, 3°03'N, 65°25'W, 180 m, 17 Feb 1990 (fl), *Aymard & Delgado 7921* (holotype: MO!; isotypes NY! U!). Fig. 1A–B.

Species *X. barbatae* valde affinis, a qua imprimis laminis foliorum angustioribus basi attenuatis et minute decurrentibus, staminibus carpellisque leviter brevioribus, et floribus aurantiacis differt.

Tree 10–21 m tall, DBH up to 25 cm; bark light gray. Leaf-bearing twigs 0.4–1.9 mm in diameter, flexuous, thickly velutinous, the dense golden patent hairs 1–1.5 mm long, persistent, marked with circular light brown lenticels. Lamina of larger leaves 3.5–6.3 cm long, 0.8–1.5 cm wide, subcoriaceous, oblong to lanceolate, occasionally elliptic, paler abaxially, cuneate to attenuate and minutely decurrent on petiole at base, acuminate to cuspidate at apex, the acumen 3.5–10 mm long, glabrous adaxially, sparsely pubescent to tomentose with midrib tomentose-woolly to puberulent abaxially, margins puberulent to tomentose; midrib impressed to plane adaxially, raised and semiterete abaxially; secondary veins 7–11 per side, departing at 40–70° from midrib, indistinctly brochidodromous, anastomosing 1.6–3 mm from margin; secondary and higher-order veins indistinct, raised adaxially, slightly raised abaxially. Petiole 0.5–1.7 mm long, 0.4–0.7 mm wide,

terete, tomentose to tomentose-woolly. Inflorescences 1–2-flowered, axillary; pedicel 1.6–4.2 mm long, 0.6–0.8 mm thick, tomentose to tomentose-woolly; bracts 2–3, 1.9–4 mm long, ovate, clasping, pubescent. Buds linear-lanceolate, acute. Calyx 2.6–4 mm long, 3.5–4.5 mm in diameter, cup-shaped, coriaceous, tomentose-woolly to tomentose; lobes 1.1–2.2 mm long, 1.8–2.4 mm wide, apiculate at apex. Corolla orange, coriaceous to fleshy; outer petals spreading slightly at anthesis, 1.7–2.4 cm long, 1.4–3 mm wide at base and 1.3–1.5 mm wide at midpoint, linear-lanceolate, acute at apex, cuneate at base, glabrous adaxially, appressed-pubescent abaxially; inner petals 1.8–2.0 cm long, 1.3–1.6 mm wide at base, 0.5–0.6 mm wide at midpoint, linear-filiform, acute at apex, expanded and concave at base, rhomboidal in cross section, glabrous adaxially, sparsely pubescent abaxially. Stamens ca. 60, 0.8–1 mm long, narrowly oblong, glabrous; anthers septate at anthesis; inner stamens staminodial. Carpels 4–5, seated in concavity of the torus; ovaries 0.7 mm long, long-sericeous; ovules 2; stigmas 3.5 mm long, coherent, filiform, pubescent. Torus 1.6 mm in diameter, conical, deeply concave, pubescent around circumference. Fruits and seeds unknown.

ADDITIONAL SPECIMENS EXAMINED. **Venezuela.** AMAZONAS: Prov. Alto Orinoco, Caño Surimoni ca. 30 min. downstream by boat (40 PS) from La Esmeralda, right tributary of Río Orinoco, 3°12'N, 65°38'W, 26 Nov 1995, *Rainer 282* (U); Río Caname, a 36 km de la confluencia con el Río Atabapo, 3°37'N, 67°07'W, Nov 1989, *Yanez 172* (US).

Plants were collected from forests in the upper Orinoco River drainage of southern Venezuela (Fig. 2); quartzite outcrops were noted in one locality. All three specimens bear flowers only; two were collected in November and one in February. *Xylopia orinocensis* has distinctly long, narrow leaves with a more attenuate lamina base than either *X. rigidiflora* or *X. barbata*, and the lamina is minutely decurrent on the petiole. The dimensions of the flower parts are similar to those of *X. barbata*. This species is not included in the recently published *Flora of the Venezuelan Guayana* (Steiermark 1995), but the combination of spreading golden pubescence, small leaves, and narrow petals over 1.7 cm long should distinguish it from any other species of *Xylopia* in the Flora area.

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