TWO NEW SPECIES OF *SOLANUM* FROM ECUADOR AND NEW COMBINATIONS IN *SOLANUM* SECTION *PACHYPHYLLA* (SOLANACEAE)

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ABSTRACT

Two new species of *Solanum* from Ecuador are described here. **Solanum manabiense** S. Stern is a member of *Solanum* section *Gonatotrichum*. It is most similar to *S. deflexum, S. turneroides,* and *S. hoffmanseggii* but differs in a unique combination of straight hairs, a rhizomatous habit, and seeds lacking swollen margins and an apical notch. It is appears to be endemic to the Pacific coast of Ecuador and has been named after the Manabí province where the type was collected. **Solanum zumbense** Bohs, named for the town of Zumba in southern Ecuador, is a member of *Solanum* section *Pachyphylla*. It is most similar to *S. obliquum*, but differs in having abundant long hairs on the foliage and axes, acute fruits, purplish, nearly glabrous corollas, and very long filaments. One new name and three new combinations are also validated in *Solanum* section *Pachyphylla*.

RESUMEN

Se describen aquí dos especies nuevas de *Solanum* de Ecuador. **Solanum manabiense** S. Stern es un miembro de *Solanum* sección *Gonatotrichum*. Esta especie es similar a *S. deflexum*, *S. turneroides*, y *S. hoffmanseggii*, pero se diferencia por tener una combinación única de pelos rectos, un hábito rizomatoso, y semillas sin márgenes hinchados ni muesca apical. Parece que es endémica a la costa pacífica del Ecuador y toma su nombre de la provincia de Manabí de donde se recolectó el tipo. **Solanum zumbense** Bohs ha sido nominada en honor al pueblo de Zumba del sur de Ecuador; esta especie es miembro de *Solanum* sección *Pachyphylla*. Es parecida a *S. obliquum*, pero se diferencia por sus frutos puntiagudos, flores de corola morada y casi glabra, y filamentos largos. También se publican un nombre y tres combinaciones nuevas en *Solanum* sección *Pachyphylla*.

Two New Species of *Solanum* from Ecuador

A comprehensive project to complete a species-level taxonomic treatment of the entire genus *Solanum*, supported by the National Science Foundation Planetary Biodiversity Inventory program, has facilitated detailed taxonomic study of many little-known groups within this giant genus (Knapp et al. 2004; http://www.nhm.ac.uk/solanaceaesource). Herbarium study and field work associated with this project have uncovered two undescribed *Solanum* species from Ecuador, which are treated below.

One of the species, *Solanum manabiense* S. Stern, belongs to *S.* section *Gonatotrichum*, a group of about five species with a disjunct distribution between Central and South America. Members of *S.* section *Gonatotrichum* include *S. deflexum* Greenm. and *S. lignescens* Fernald from Central America, *S. turneroides* Chodat and *S. hoffmanseggii* Sendtn. from northern Argentina, Bolivia, Paraguay, and into the Mato Grosso do Sul region of Brazil, and *S. adscendens* Sendtn., endemic to southern Brazil. Molecular phylogenetic analyses indicate that members of *S.* section *Gonatotrichum* form a monophyletic group that is part of the Brevantherum clade of Bohs (2005) and Weese and Bohs (2007). Species of this group are distinctive in the genus due to their explosive fruit dehiscence. The fruits are watery, with a thin exocarp, and build up internal pressure as they mature until they burst, explosively expelling the seeds. Plants of this group are generally diminutive annuals or herbaceous perennials with short, few-flowered inflorescences and simple, sometimes geniculate hairs. This group was studied by Nee (1989), who recognized two species. However, Nee annotated a specimen of the new species described below as *S. manabiense,* as *S. deflexum* vel. aff., which he later synonymized with *Solanum adscendens*. Detailed taxonomic study has reevaluated the circumscription and species limits of section *Gonatotrichum* and has revealed *S. manabiense* to be a distinct species.

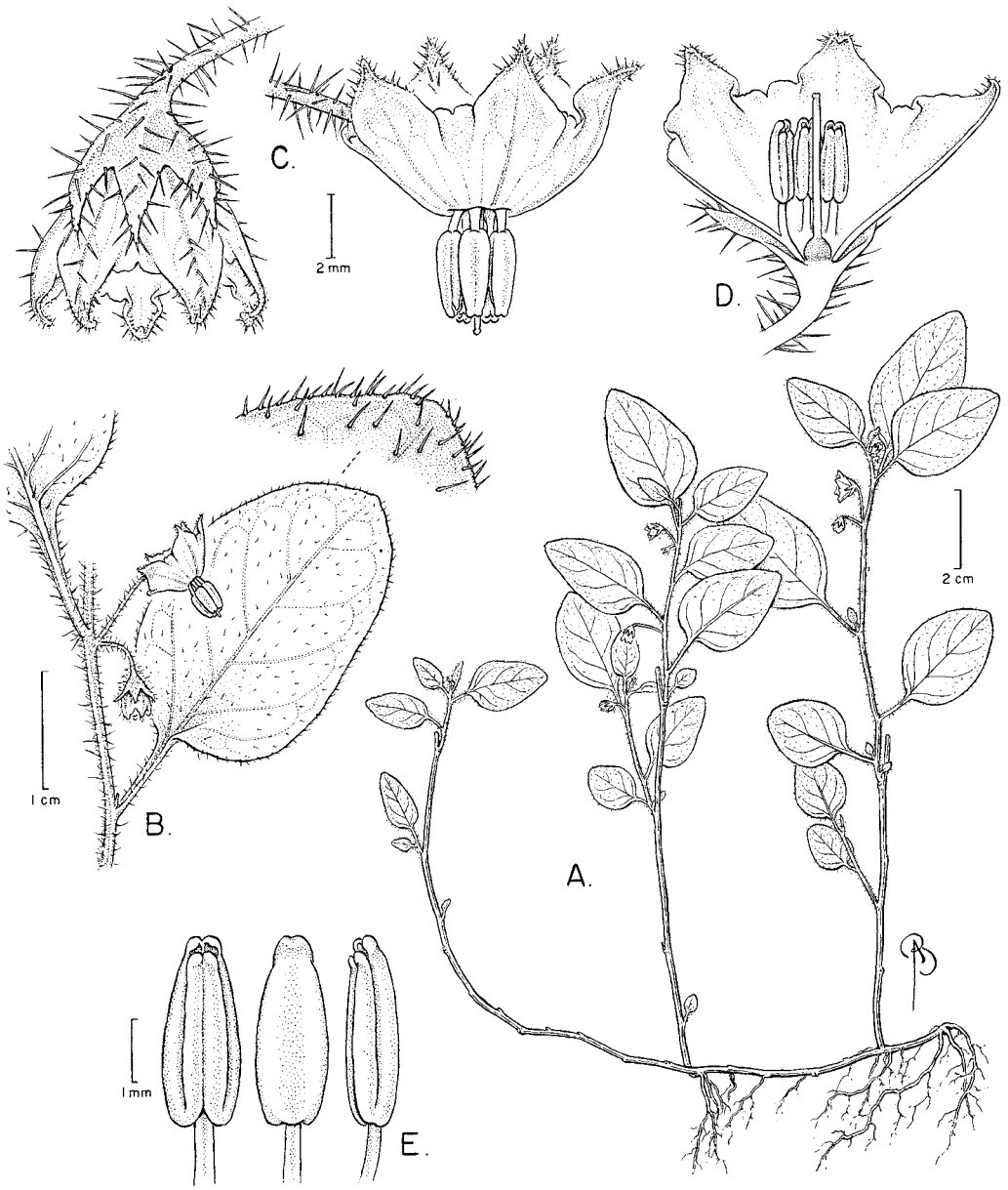

Fig. 1. *Solanum manabiense* S. Stern. A, B. Habit. C. Bud (left) and opened flower (right). D. Flower cross section. E. Stamens. All from *T. Plowman & P. Alcorn 14334* (NY)

Solanum manabiense S. Stern, sp. nov. (**Figs. 1–2**). Type: ECUADOR. Manabí: Pacoche Reserve, road from Manta to San Lorenzo, ~2 km W of El Aromo, 01°04'09.5"S, 80°52'32"W, 350 m, 8 Feb 2009 (fl, fr), *S. Stern & E.J. Tepe 377* (holotype: QCNE; isotypes: BM, F, MO, NY, QCA, UT).

Solano deflexo et *S. hoffmanseggii* affinis sed a *S. deflexo* habitu rhizomatoso et seminibus sine margine tumido et incisum apicali, a *S. hoffmanseggii* pilis non geniculatus differt.

Rhizomatous herb, sometimes slightly woody at the base, 1.5–4 dm tall. Stems sparsely to densely pubescent

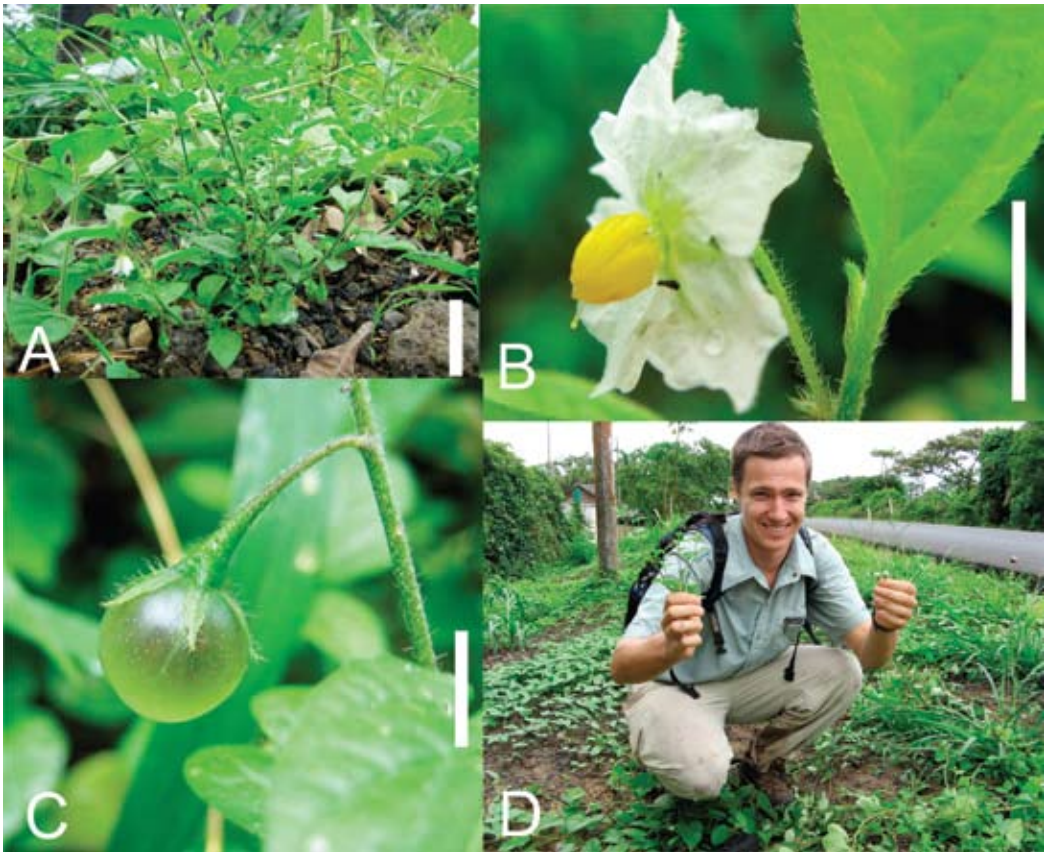

Fig. 2. Photos of type collection of *Solanum manabiense* S. Stern. A. Habit. B. Flower; note hairs on stem and leaves. C. Fruit, with skin becoming transparent as water pressure increases. D. Roadside habitat in Manabí, Ecuador and author with type collection. Scale lines A = 10 cm. B, C = 5 mm.

with two celled unbranched, straight hairs, unarmed. Sympodial units difoliate, geminate. Leaves simple, 1–6 × 0.5–3 cm, elliptic to elliptic-ovoid, chartaceous to membranaceous, nearly glabrous to sparsely pubescent adaxially and abaxially with one- to two-celled, unbranched, straight hairs, these lying flat along the blade, denser along veins; base rounded to obtuse, often decurrent into petiole; margin entire and ciliate with unbranched hairs; apex acute to obtuse; petioles 0.5–1 cm, moderately pubescent with unbranched straight hairs. Inflorescence sessile, extra-axillary or subopposite the leaves, unbranched, with 1–5 flowers, all flowers perfect, the axes sparsely to moderately pubescent with unbranched hairs; peduncle absent; rachis absent to ca. 1 mm; pedicels 5–15 mm in flower, 10–20 mm in fruit, nearly contiguous, articulated at the base. Flowers homostylous, 5-merous. Calyx 3–10 mm long, the tube 1–3 mm, the lobes 2–7 × 0.5–1.5 mm, linear-lanceolate, moderately to densely pubescent; fruiting calyx not accrescent, not completely covering the fruit. Corolla 0.4–1 cm in diameter, 2–3 mm long, rotate with abundant interpetalar tissue, chartaceous to membranaceous, white, the tube 2–3 mm long, the lobes very short, 1–2 × 0.5–1 mm, triangular, acute at apices, sparsely to moderately pubescent abaxially and on margin with 2–3-celled unbranched, straight hairs, glabrous adaxially. Stamens 2–4 mm long; filaments up to 1 mm long, glabrous; anthers 1.5–3 × 0.5–1.5 mm, oblong, connivent, yellow, the base cordate, the apex emarginate, the pores directed introsely and subapically, not opening into longitudinal slits. Ovary glabrous; style 4–6 × 0.5–1 mm, equal to or exserted beyond stamens, cylindrical, glabrous; stigma up to 1 mm wide, capitate. Fruit a globose berry,

5–12 mm in diameter, white to yellow when immature, maturing semitransparent, drying brown, glabrous, the mesocarp watery and held under pressure until dehiscing explosively at maturity. Seeds 10–35 per fruit, ca. 2.5 × 1.5 mm, somewhat flattened, with a small notch where connected to placenta, the margin not swollen, the surface with fine raised ridges radiating from the center to the edges and shallow ridges running parallel to margin.

Distribution and phenology.—Known only from the central coast of Ecuador in Provs. Manabí and Guayas from sea level to 400 m. Flowering and fruiting specimens have been collected in February and July.

Solanum manabiense is unique in section *Gonatotrichum* due to the combination of its rhizomatous habit; difoliate, occasionally geminate sympodia; leaves glabrous on the abaxial surface; unbranched, straight (non-geniculate) hairs; small flowers with equal stamens; and seeds with unexpanded margins and no obvious notch at the attachment point to the placenta. It is apparently restricted to coastal Ecuador in the Guayas and Manabí provinces. It is named for the latter province where the type was found and the species is apparently a common roadside weed.

Solanum manabiense resembles *S. hoffmanseggii*, but the hairs of *S. hoffmanseggii* are geniculate whereas those of *S. manabiense* are straight. *Solanum manabiense* also resembles *S. turneroides*, but *S. turneroides* is a more robust herb with heterantherous flowers that are much larger than those of *S. manabiense*. *Solanum manabiense* is also similar to *S. deflexum*, but the latter has densely pubescent leaves, is not rhizomatous, and has seeds with a swollen margin and pronounced notch where they connect to the placenta.

Parsimony analyses of sequence data from three molecular markers (nuclear *waxy* or GBSSI and ITS and chloroplast *trnT-F*) place *Solanum manabiense* in the *Gonatotrichum* clade (S. Stern, unpub. data). The *waxy* and combined analyses place *S. manabiense* sister to a clade containing the South American species *S. hoffmanseggii* and *S. turneroides*. The Central American *S. deflexum* and *S. lignescens* clade is more distantly related. *Solanum manabiense* is the only species of *S.* section *Gonatotrichum* known from northern South America.

Paratypes: **ECUADOR. Guayas:** 2 to 4 km E from Recinto Olon, ca. 10 km N of Manglaralto, 19 Feb 1974, *Gentry 10068* (MO). **Manabí:** Montecristi, Cerro Montecristi, eastern slopes above town, 18 Jul 1986, *Plowman & Alcorn 14334* (F, NY, QCA).

The second new species, *Solanum zumbense*, belongs to the Cyphomandra clade of *Solanum* along with other species traditionally recognized in *S.* sections *Pachyphylla* and *Cyphomandropsis* Bitter (Bohs 2005, 2007). Many members of this clade were formerly segregated as the genus *Cyphomandra* due to their enlarged anther connectives, which function as osmophores for the attraction of male euglossine bees (Bohs 1994). Subsequent phylogenetic research revealed that *Cyphomandra* is deeply nested within *Solanum*, necessitating the transfer of all of its species to *Solanum* (Bohs 1995). Monophyly of the group of species with enlarged anther connectives has not been conclusively demonstrated, but monophyly of the more inclusive group of species comprising the Cyphomandra clade is well-supported (Bohs 2005, 2007; Weese & Bohs 2007).

Monographs have been published for species of the Cyphomandra clade (Bohs 1994, 2001), but novelties continue to be discovered. Specimens of the following new species were annotated as *S.* sp. aff. *obliquum* or *S.* sp. nov. by Bohs during the preparation of her 1994 treatment. Some collections recognized here as *S. zumbense* were noted in the monograph as being anomalous within *S. obliquum* Ruiz & Pav., but at that time there was some doubt about their status as a distinct species. Subsequent assessment of herbarium and living material confirm that these collections represent a new species.

Solanum zumbense Bohs, sp. nov. (**Fig. 3**). Type: ECUADOR. Zamora-Chinchipe: road between Zumba and Amaluza, 8–10 km W of Zumba, 04°50'07"S, 79°09'50"W, 1500–1700 m, 31 Mar 2005 (fl, fr), *L. Bohs et al. 3366* (holotype: QCNE; isotypes: BM, LOJA, NY, QCA, UT).

Solano obliquo simile sed corollis purpurascibus filmentis longis et fructibus acutis differt.

Shrub or small tree 1–3 m tall, from a single trunk with a spreading crown. Stems densely puberulent with unbranched glandular and eglandular hairs and often also sparsely to moderately pilose with eglandular hairs 1–3 mm long. Sympodial units 3–4-foliate, geminate or not. Leaves simple, the blades 4–25 × 2.3–24 cm, 1–2.5 times as long as wide, subcoriaceous, ovate, sparsely to densely puberulent adaxially and abaxi-

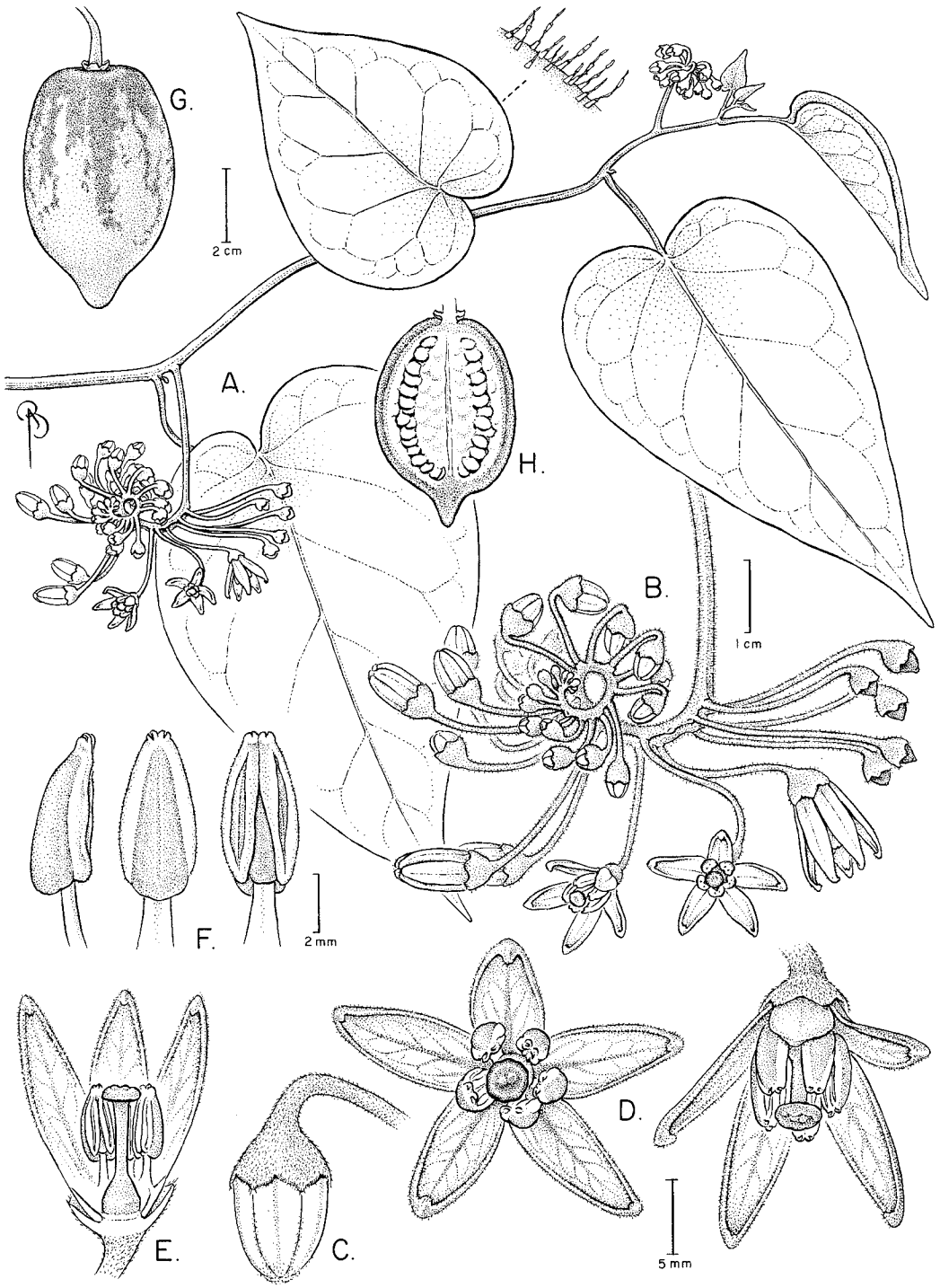

Fig. 3. *Solanum zumbense* Bohs. **A.** Leaves and inflorescence. **B.** Inflorescence detail. **C.** Bud. **D.** Flower in face-on (left) and side view (right). **E.** Flower cross-section. **F.** Stamens. **G, H.** Fruits. All from *Bohs et al. 3366*.

ally with unbranched eglandular hairs and often also sparsely to densely pilose with unbranched hairs 1–3 mm long, the hairs more dense on veins; major veins ca. 5 per side; base truncate to deeply cordate, often oblique, with basal lobes (0–)0.5–3.5 cm; margin entire; apex acuminate; petioles 3–10 cm, densely puberulent and often also sparsely to moderately pilose. Inflorescences 3–12(–25) cm long, leaf-opposed or in a branch fork, unbranched, forked, or rarely further branched, with 15–40 flowers, all flowers perfect, the axes densely puberulent (-pilose); peduncle 1.5–5 cm; rachis 1–6.5 (–20) cm; pedicels 15–25 mm, 25–40 mm in fruit, spaced 1–6 mm apart, articulated near the base and leaving pedicellar remnants ca. 1 mm long. Buds ellipsoidal or ovoid, acute at apex. Flowers homostylous, 5-merous. Calyx 3–5 mm long, the tube 2–4 mm, the lobes 1–2 × 2–3 mm, deltate to very shallow, apiculate at tips, subcoriaceous, moderately to densely puberulent, with hairs denser toward tips of lobes; fruiting calyx not accrescent. Corollas 1.5–2 cm in diameter, 12–16 mm long, stellate, coriaceous, dull greenish, violet, or brownish-purple, the tube 1–2 mm, the lobes 9–14 × 3–4 mm, narrowly triangular, acute and slightly cucullate at apices, glabrous abaxially, glabrous to sparsely puberulent adaxially on midrib and toward apices, the margin tomentose to ciliate. Stamens with the free part of filaments 2–4 mm long, the filament tube 1–2 mm; anther thecae 4–5 × 1.5–2 mm, lanceolate, loosely connivent, cream to purplish, the pores directed abaxially and distally, not opening into longitudinal slits; connective 4–5 × 1.5–2 mm, lanceolate, purple or brownish, abaxially slightly shorter than thecae at apex, slightly exceeding them at base, adaxially produced as a swelling ca. 3 × 1 mm. Ovary glabrous or finely puberulent; style 4–7 × 0.5–1 mm in diameter at base, 1.5–2.5 mm in diameter at apex, equal to or shorter than the stamens, umbrella-shaped, strongly dilated distally, glabrous; stigma truncate, 1.5–2.5 mm in diameter, with two prominent apical glands. Fruits 6–7 × 1.5–4.5 cm, ellipsoidal to fusiform, acute to apiculate at apex, pale yellow when mature, glabrous to finely puberulent; stone cell aggregates large. Seeds 5–6 × 3–4 mm, flattened, reniform, rugulose to pubescent along margin with white pseudohairs.

Distribution and phenology.—Clearings and open places in tropical rain forest, (400–)1500–2255 m in elevation, eastern Andean slopes in southern Ecuador and Peru, with an outlying collection from Brazil. Flowering specimens have been collected in March, July, September, November, and December. Fruiting specimens have been collected in March through June and December.

Local names.—Peru: chupo sacha (*Schunke 5866*); tomato del campo (*Mexia 8235*). Brazil: tsetsepere (Deni; *Prance et al. 16402*).

Uses.—*Mexia 8235* describes the fruits as having a tomato-like taste, and *Bohs et al. 3366* describe them as sweet-sour. In Amazonian Brazil, the leaves are heated in water and used to bathe babies, both to keep them healthy and to cure fever (*Prance et al. 16402*). *Schunke 5866* reports that an infusion is given in an enema to combat the grippe.

Within the Cyphomandra clade, *S. zumbense* is most similar to *S. obliquum*. Both species have very broad stigmas with two apical glands, short anthers with the connective not prolonged below the bases of the anther thecae, and stellate, coriaceous corollas with relatively broad and spreading lobes. *Solanum zumbense* differs from *S. obliquum* in having abundant long hairs on the foliage and axes, pointed and often pubescent fruits, and purplish, nearly glabrous corollas. The filaments are quite long and are a distinctive feature. *Solanum zumbense* is found at higher elevations (above 1500 m) than typical plants of *S. obliquum*.

Solanum zumbense takes its name from the town of Zumba in southern Ecuador near the Peruvian border, where the type collection was made. Although this locality is in the northern extremity of the range of this species, the euphonious epithet was too good to pass up. "Zumbar" is also the Spanish word for "buzz," a common pollination mechanism in many species of *Solanum*.

Paratypes. **ECUADOR. Zamora-Chinchipe:** trail between Mirador and Pallas, 2010–2255 m, 9 Sep 1943 (fl), *Steyermark 54279* (NY). **Peru. Amazonas:** Prov. Amazonas, Dist. Vista Alegre, Sector Romero, ca. 1 km de Vista Alegre, 06°10'S, 77°18'W, 1540–1720 m, 1 Jul 1998 (fl), *Sánchez Vega & Zapata 9595* (F). **Huánuco:** Dist.: Churubamba, trail Puente Durand to Exito, 1625 m, 26 Sep 1936 (fl, fr), *Mexia 8235* (B, BH, BM, F, GH, K, MO, NY, S, U, US); Prov. Leoncio Prado, Dist. Hermilio Valdizán, La Divisoria, 21.8 km E of Puente Pumahuasi (Río Tulumayo) on road from Tingo María to Pucallpa, ca. 09°05'S, 75°52'W, 1550 m, 27 Dec 1981 (fr), *Plowman & Schunke 11724* (F, GH, MO); Agua Blanca (carretera Monzón), 22 Apr 1962 (fr), *Schunke 5866* (F, US); Prov. Huánuco, km 474 on Lima-Tingo

María road, Huánuco, 1650 m, 2 Jun 1981 (fr), *Young & Sullivan 634* (NY). **Pasco:** Oxapampa, ca. 2 km E of village, 10°35'S, 75°35'W, 1850 m, 10 Mar 1984 (fl, fr), *Knapp et al. 6315* (BH, F, G, GH, MO, NY, US); Prov. Oxapampa, 5 km SE of Oxapampa, 75°23'W, 10°36'S, 1850 m, 13–16 Dec 1982 (fl, fr), *D. Smith 2959* (F, NY); Oxapampa Prov., Palcazu valley, Río San José in the Río Chuchurras drainage, 75°20'W, 10°09'S, 400–500 m, 14 May 1983 (fr), *Smith 4023* (NY). **San Martín:** prope Tarapoto, 1855–6, *Spruce 4941* (NY). **Ucayali:** Prov. Coronel Portillo, Cordillera Azul, km 43 on Tingo María-Pucallpa road, ca. 1500 m, 5 Jun 1981 (fr), *Young & Sullivan 741* (MO). **BRAZIL. Amazonas:** basin of the Rio Purus, Rio Cunhuá at Canaçã, 06°34'S, 66°27'W, 27 Nov 1971 (fl), *Prance et al. 16402* (NY).

NEW COMBINATIONS IN *SOLANUM* SECTION *PACHYPHYLLA*

Bohs (1995) transferred the epithets of all *Cyphomandra* species to *Solanum*. However, transfers of infraspecific taxa were not made at that time. The combination *Solanum corymbiflorum* subsp. *mortoniana* (L.B. Sm. & Downs) Bohs was published in Zuloaga et al. (2007) and the citation is included here for completeness. The following new combinations will validate the remaining infraspecific taxa belonging to *S.* sect. *Pachyphylla*.

Solanum circinatum Bohs subsp. **ramosum** (Bohs) Bohs, comb. nov. Basionym: *Cyphomandra hartwegii* (Miers) Walpers subspecies *ramosa* Bohs, Revista Acad. Colomb. Ci. Exact. 16:73. 1988. Type: COLOMBIA. Huila: Fundación Merenberg, ca. 1300 m, 18 Aug 1981 (fl, fr), *L. Bohs 1644* (holotype: COL; isotypes: CAUP, GH).

Solanum corymbiflorum (Sendtn.) Bohs subsp. **mortonianum** (L.B. Sm. & Downs) Bohs, Darwiniana 45:241. 2007 (as "subsp. *mortoniana*"). Basionym: *Cyphomandra mortoniana* L.B. Sm. & Downs, Phytologia 12:250. 1965. *Cyphomandra corymbiflora* Sendtn. subsp. *mortoniana* (L.B. Sm. & Downs) Bohs, Fl. Neotrop. Monogr. 63:68. 1994. Type: BRAZIL. Santa Catarina: São Joaquim, near Mantiqueira (27 km E of São Joaquim), 1100–1200 m, 16 Jan 1957, *L.B. Smith & R. Reitz 10219* (holotype: US; isotypes: GH, HBR, R).

Solanum diversifolium Dunal subsp. **chloranthum** (Rusby) Bohs, comb. nov. Basionym: *Cyphomandra chlorantha* Rusby, Descr. S. Amer. Pl. 116. 1920. *Cyphomandra diversifolia* (Dunal) Bitter subspecies *chlorantha* (Rusby) Bohs, Fl. Neotrop. Monogr. 63:82. 1994. Type: COLOMBIA. Santa Marta: Valparaiso, rare in damp clearings, flowers Jan to Apr, 4500 ft, 26 Jan–25 Feb 1899 (fl, fr), *H.H. Smith 1180* (lectotype, designated by Bohs 1994: NY; isolectotypes, A, F, G, GH, K, L, LL, MO, NY, P, S, U, US, W, WIS).

Solanum endopogon (Bitter) Bohs subsp. **guianense** (Bohs) Bohs, comb. nov. Basionym: *Cyphomandra endopogon* Bitter subspecies *guianensis* Bohs, Fl. Neotrop. Monogr. 63:90. 1994. Type: FRENCH GUIANA. Saul, Monts La Fumée, 3°37'N, 53°12'W, 200–400 m elev., 16 Aug 1982 (fl), *S. Mori & B. Boom 14709* (holotype: F).

In addition to validating these infraspecific names, molecular evidence in Bohs (2007) indicates that *S. circinatum* subsp. *ramosum* might be better recognized as a distinct species. The combination *S. ramosum* Lam. has already been published; therefore a new epithet must be coined for this taxon. The epithet *huilense* commemorates the predominant distribution of the plants, in Dept. Huila, Colombia.

Solanum huilense Bohs, nom. nov. for *Solanum circinatum* Bohs subsp. *ramosum* (Bohs) Bohs. Basionym: *Cyphomandra hartwegii* (Miers) Walpers subsp. *ramosa* Bohs, Rev. Acad. Colomb. Ci. Exact. 16:73. 1988. Type: COLOMBIA. Huila: Fundación Merenberg, ca. 1300 m, 18 Aug 1981 (fl, fr), *L. Bohs 1644* (holotype: COL; isotypes: CAUP, GH).

ACKNOWLEDGMENTS

We thank J. Bennett, J. Clark, and E. Tepe for field assistance; the herbaria listed for loans of specimens; and Bobbi Angell for the drawings. This work was supported by NSF grant DEB-0316614 (PBI *Solanum*: A Worldwide Treatment) to LB. Gregory J. Anderson and an anonymous reviewer provided critical reviews.

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