Two new Peruvian species of *Jaltomata* (Solanaceae, Solaneae) with red floral nectar

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Abstract. Two new *Jaltomata* species (Solanaceae) of Peru that produce red floral nectar are described. **Jaltomata neei** of Department Cajamarca has 1–4 flowers per inflorescence, the campanulate corolla is green and then changes to blue, corolla lobes (5) and lobules (5) are equally prominent, a corona is lacking, five radial staminal-corolla thickenings create nectar troughs between, and the stigma is capitate. **Jaltomata quipuscoae** of Department Arequipa has solitary flowers, a purple, broadly crateriform, 5-lobed corolla, a corona on which nectar pools, a punctiform stigma, lacks corolla thickenings, and the mature fruit is whitish. Photographs, illustrations and tables are included that allow comparison with closely related species.

Key Words: Arequipa, Cajamarca, corolla color change, corona, *Jaltomata neei*, *Jaltomata quipuscoae*, protogyny, Peru, red nectar..

The genus *Jaltomata* (Solanaceae) includes about 70 species of herbs and shrubs, distributed from Arizona in the United States to Bolivia, and there are two insular species (*J. antillana* [Krug & Urban] D'Arcy, Greater Antilles; *J. werffii* D'Arcy, Galápagos Islands). *Jaltomata* can be found throughout Andean Peru from near sea-level to about 4000 m of elevation. There are three major clades in the genus. Species of the orange-fruited clade (Miller et al., 2011) grow in South America, are mostly woody, and express the full range of corolla forms and colors (described below). The species of the red-fruited clade grow in South America and the Greater Antilles, are herbaceous to suffrutescent, and have rotate, white to pale-yellow corollas. In contrast, the species of the black-fruited clade grow mostly in Mexico and Central America, are mostly herbaceous, and have only rotate, greenish corollas. Green fruits, characteristic of few species, evolved independently in the orange-fruited and the black-fruited clades (Miller et al., 2011). This paper is a contribution to ongoing taxonomic studies of the genus (Mione, 1992; Leiva González & Mione, 1999; Mione & Serazo, 1999; Mione et al., 2000; Mione et al., 2004, 2011, 2013; Leiva González et al., 2010).

The species of *Jaltomata* have simple, alternate (often geminate) leaves and pentamerous flowers with five corolla lobes, or ten total lobes plus lobules. The corolla form varies greatly, depending on the species (tubular, urceolate, crateriform, campanulate-rotate, or rotate). The inflorescence is umbellate. A subset of the species of the orange-fruited clade have radially oriented staminal-corolla thickenings, adnate to the base of each stamen and extending toward the corolla lobule (or to the area where the lobule, when lacking, would be). Between the radially oriented staminal-corolla thickenings are troughs, visible to the unaided eye, that hold nectar at the base of the corolla (Bitter, 1924; Fig. 2B). The ovary of all species has a basal disk, and anthers dehisce longitudinally. Filaments of all but three species insert into the lower ventral face of the anther. The calyx is accrescent but never encloses the berry. Dendritic hairs are uniseriate, many-celled and have three or more branches emerging at different

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levels. Forked hairs are also uniseriate and many-celled but have only two termini. Finger hairs are uniseriate and unbranched. In the following descriptions, hairs are not gland-tipped and are unpigmented unless indicated otherwise. Pollen size is based on 30 grains in polar view stained with analine blue in lactophenol.

During fieldwork in 2007, 2010 and 2013 we collected the following two new species.

Jaltomata neei Mione & S. Leiva, **sp. nov**. Type: Peru. Dept. Cajamarca: Prov. San Miguel, 7° 00.744 S, 78° 50.188 W, road from San Miguel de Pallaques to Llapa, 2645 m, 27 Mar 2013, *S. Leiva G., T. Mione & L. Yacher 5426* (holotype: HUT; isotype: NY). (Figs. 1, 2)

Diagnosis: Inflorescence 1–4 flowered, corolla campanulate and green changing with age to blue, corolla lobes and lobules equally prominent, radial staminal-corolla thickenings (five) creating nectar troughs (five) between, corona lacking, stigma capitate.

Shrub 1–2 m high, the young branches green, pubescent with erect, dendritic and forked hairs, somewhat angular to nearly terete, the older stems brown, glabrous, with lenticels, hollow, terete, and to 12 mm diameter. Leaves alternate or geminate (Fig. 1D), the blade to 8 cm long ×4.8 cm wide, darker green above, ovate to ovate-lanceolate, the apex acute, the base of some leaves somewhat truncate, both faces densely pubescent, the hairs erect and dendritic; petiole 1.1–3.9 cm long. Inflorescence 1–4 flowered. Peduncle 4–8 mm long, green at flowering, nearly terete, pubescent with erect, dendritic and forked hairs; pedicel 11–18 mm long, green at flowering, angular in cross section at the distal end, pubescent with erect, dendritic and forked hairs. Calyx green, 16–18 mm diameter, subplanar, glabrous internally, pubescent externally, especially on the veins, the hairs dendritic, at fruit maturity hiding 1/3 of the fruit in side view, at least 25 mm diameter probably somewhat larger (fruits were not ripe at the time of collection). Corolla green, later turning blue, the red nectar showing through the wall of the corolla (Fig. 2A), and purple pigmentation of the corolla showing at the bottom of the nectar troughs after nectar is removed and in side-view of flower, campanulate with a planar limb, 8.5–13 mm long × 25–39 mm diameter, the lobes alternating with lobules together totaling 10 (Fig. 2B), externally with dendritic hairs on veins and glabrous between veins, internally the hairs simple, erect, gland-tipped, and evenly distributed. Stamens 11–12 mm long, exserted beyond distal end of corolla 0–3 mm, the radially oriented staminal-corolla thickenings extending toward corolla lobule with copious red nectar pooling in troughs between thickenings, the filament base expanded laterally (ventral view), the filaments connivent, pale-green, pilose only at the base (Fig. 1J), the anther yellow with a green connective prior to dehiscence, 2.5 mm (herbarium specimen) to 3 mm (fresh) long, mucronulate (evident only with a dissecting microscope prior to dehiscence), the filament inserting into ventral face of the anther, the anthers of a flower opening asynchronously; pollen grains 32.75–38.75 μm (mean 35.34) diameter. Stigma capitate, bilobed, darker green than the style (Fig. 2A); style 11–13 mm long, straight, pale-green, exserted 5 mm beyond mouth of corolla; ovary green, 3 mm high ×3 mm wide, the disk orange and half as high as the ovary (Fig. 1E); ovules per ovary 170–196 (n = 2 flowers). Fruit 9–11 × 13–16 mm; color (at maturity) not seen, almost certainly orange.

Additional specimens examined. PERU. Cajamarca: Prov. San Miguel, same locality and date as the type specimen, *Mione et al. 833* (F); Visita Alegre, Niepos, 2400 m, "1-11-1985," *S. Llatas Quiroz 1575* (F); 6° 59.001 S, 78° 48.237 W, 2919 m, 20 Mar 2007, *S. Leiva G. et al. 3643* (HAO), *Mione et al. 740* (F); 6° 58' 25" S, 78° 47' 58" W, 2840 m, 18 June 1999, *S. Leiva G. et al. 2370* (HAO), *Mione et al. 669* (CCSU).

Jaltomata neei grows in Peru, Department Cajamarca, Province San Miguel, between 2400 and 2920 m in the native vegetation along roadsides. The flowers are protogynous (Fig. 2B). Younger flowers have a green corolla and are pistillate: they are fully open but anthers have not yet dehisced. Older flowers have a blueish corolla and dehisced anthers, and thus are functionally hermaphroditic. The dehiscence of the anthers and the corolla color change from green to blue are not always synchronous; some flowers in the field had both a bluish corolla and anthers that had not yet dehisced. Red nectar is produced by flowers in both the pistillate and hermaphroditic phases. In the phylogeny of Miller et al. (2011) this species was referred to as *J.* "rednectar."

Table I compares *Jaltomata neei* with similar congeneric species: shrubs having a campanulate corolla, copious red/orange nectar, radial staminal-corolla thickenings creating five nectar

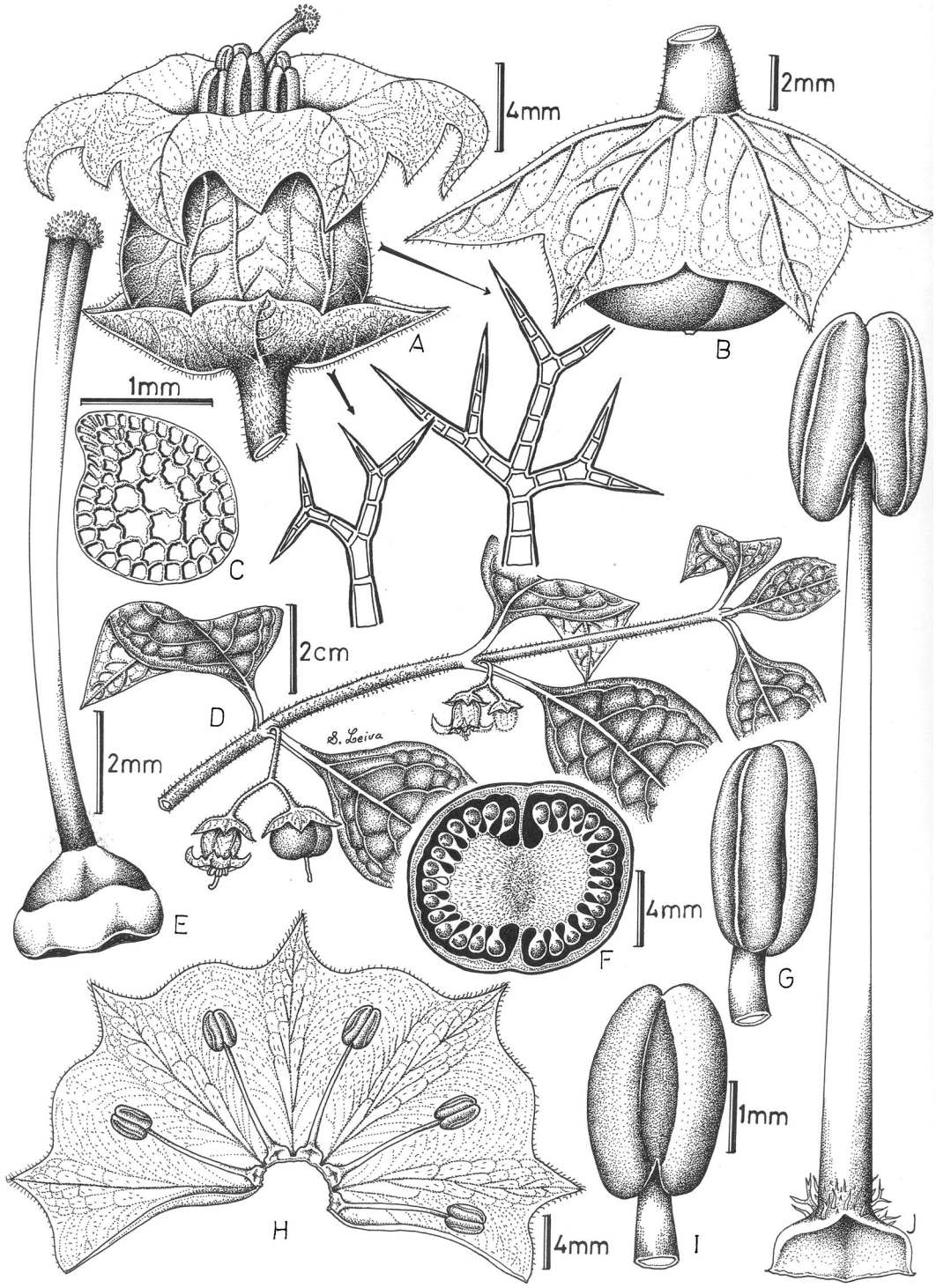

FIG. 1. *Jaltomata neei.* **A.** Flower, side view, with dendritic hairs expanded. **B.** Berry with calyx, side view. **C.** Seed. **D.** Branch with leaves flowers and fruit. **E.** Gynoecium including basal disk. **F.** Ovary, cross section. **G.** Anther, lateral view. **H.** Corolla dissected to show the insertion of the stamens. **I.** Anther, dorsal view. **J.** Stamen, ventral view. (Drawn from *S. Leiva G. et al. 5426*).

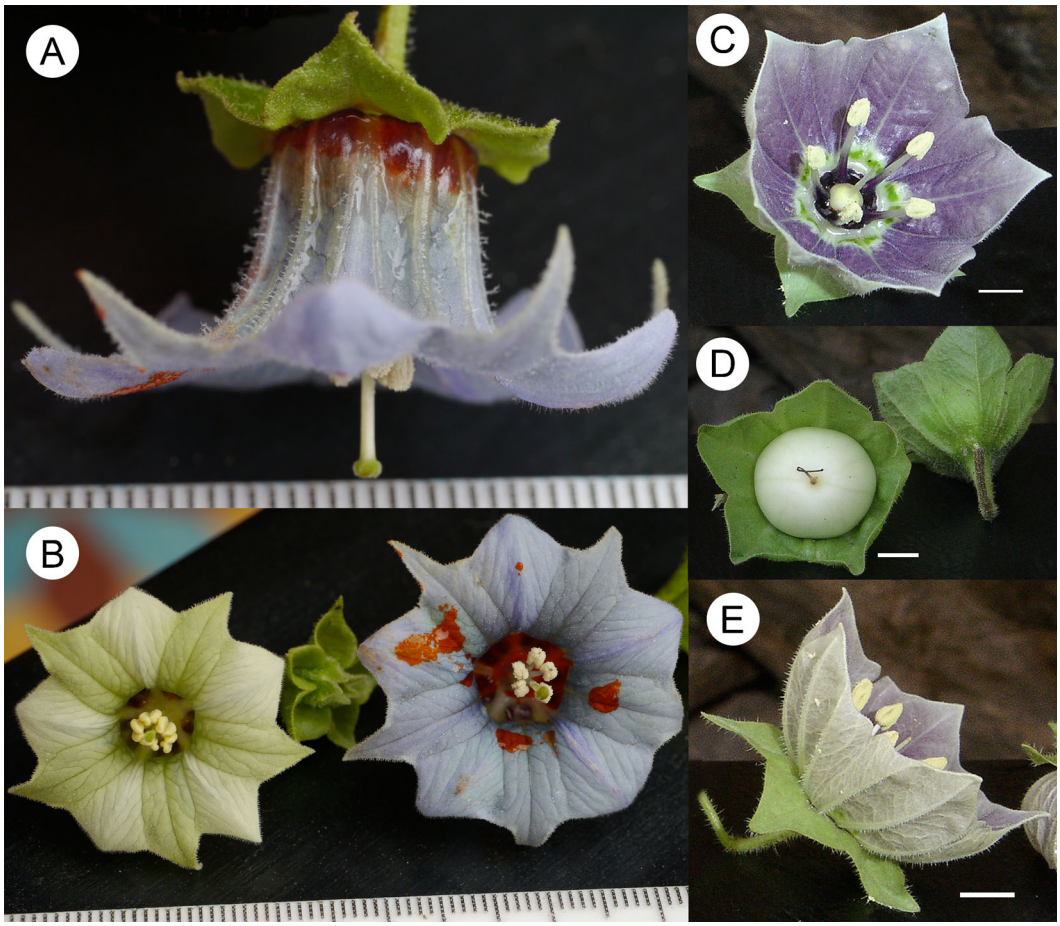

FIG. 2. *Jaltomata neei* (**A**, **B**) and *J. quipuscoae* (**C**–**E**). **A.** Flower, side view. **B.** Flowers, front view, pistillate phase (anthers undehisced) on left, and hermaphroditic phase (anthers dehisced) on right. **A**, **B**: Units along bottom of photos are mm; photos by T. Mione. **C.** Flower, all anthers dehisced. **D.** Fruit. **E.** Flower, side view. **C**–**E**: All scale bars represent 0.5 cm; photos by Victor Quipuscoa S.

troughs (one trough between each pair of thickenings) and no corona. *Jaltomata leivae* Mione and *J. ventricosa* (Baker) Mione were omitted from Table I because the corolla is urceolate, and *J. alviteziana* S. Leiva was omitted because its corolla is tubular, but these species otherwise share these features. *Jaltomata umbellata* (Ruiz & Pav.) Mione & M. Nee also has copious red nectar, but was omitted from Table I because it has a tubular corolla and lacks radial staminal-corolla thickenings (Mione et al., 1993).

The name of this species was chosen to honor Dr. Michael Nee, eminent Solanologist.

Jaltomata quipuscoae Mione & S. Leiva, **sp. nov.**

Type: Peru. Arequipa: Prov. Arequipa, Distrito Yarabamba, 16° 33' 58.6" S, 71° 25' 40.6" W, alrededores de Petroglifos de Sogay, ladera arbustiva, rocosa, 2625 m, 11 Feb 2006, *V. Quipuscoa S., G. Castillo P., K. Arce C. 3352* (holotype: HUSA; isotype: NY). (Figs. 2, 3)

Diagnosis: Flowers solitary, corolla purple, broadly crateriform and 5-lobed, nectar pools on the corona, lacking radial staminal-corolla thickenings, stigma punctiform, mature fruits whitish.

Much branching, perennial herb to 70 cm, the younger branches green with a dense pubescence of gland-tipped finger hairs, the older branches brown-purple, lacking lenticles. Leaves alternate, sometimes geminate, the blades ovate to elliptical, to 4.8 cm wide ×7.5 cm long, the base symmetrical or nearly so, adaxially and abaxially pubescent with gland-tipped finger hairs, the margin nearly

TABLE I
COMPARISON OF *JALTOMATA NEEI* WITH OTHER SHRUBBY *JALTOMATA* HAVING A CAMPANULATE COROLLA, COPIOUS RED/ORANGE NECTAR, AND RADIAL STAMINAL-COROLLA THICKENINGS CREATING FIVE NECTAR TROUGHS, ONE TROUGH BETWEEN EACH PAIR OF THICKENINGS.

Species	*J. neei Mione & S. Leiva*	*J. paneroi Mione & S. Leiva*	*J. herrerae (C. V. Morton) Mione*	*J. dendroidea S. Leiva & Mione*	*J. grandibaccata S. Leiva & Mione*	*J. weberbaueri (Dammer) Mione*
Distribution	Peru: Cajamarca	Peru: Cajamarca	Peru: Cuzco, Apurimac, Ayacucho. Bolivia: La Paz.	Peru: La Libertad	Peru: La Libertad	Peru: Ancash
Altitude (m)	2400–2920	3240–3500	3000–3750	3100–3360	3450–3680	2800–3795
Calyx when flowering, diameter (mm)	16–18	13	21–26	17–21	23–35	29–41
Calyx lobes	as long as wide	as long as wide	longer than wide	as long as wide	as long as wide	longer than wide
Calyx when flowering, having an abaxial keel where sepals meet	no	no	no	no	yes	yes
Corolla color	green turning to blue	green	green	green	blue-green to blue	purple to violet
Corolla length, proximal to distal (mm)	8.5–13	5–10	10–15	10–13	20	20–35
Corolla diameter, lobe tip to lobe tip (mm)	25–39	23–35	30–40	23–30	35–47	40–60
Alternating corolla lobes and lobules	lobes (5) and lobules (5) equally prominent	lobes (5) conspicuously longer than lobules (5)	lobes (5) conspicuously longer than lobules (5)	lobes (5) conspicuously longer than lobules (5)	lobes (5) and lobules (5) nearly equally prominent	lobes (5), lobules (0)
Style length (mm)	11–13	11–14	14	12–17	19–23	15–22

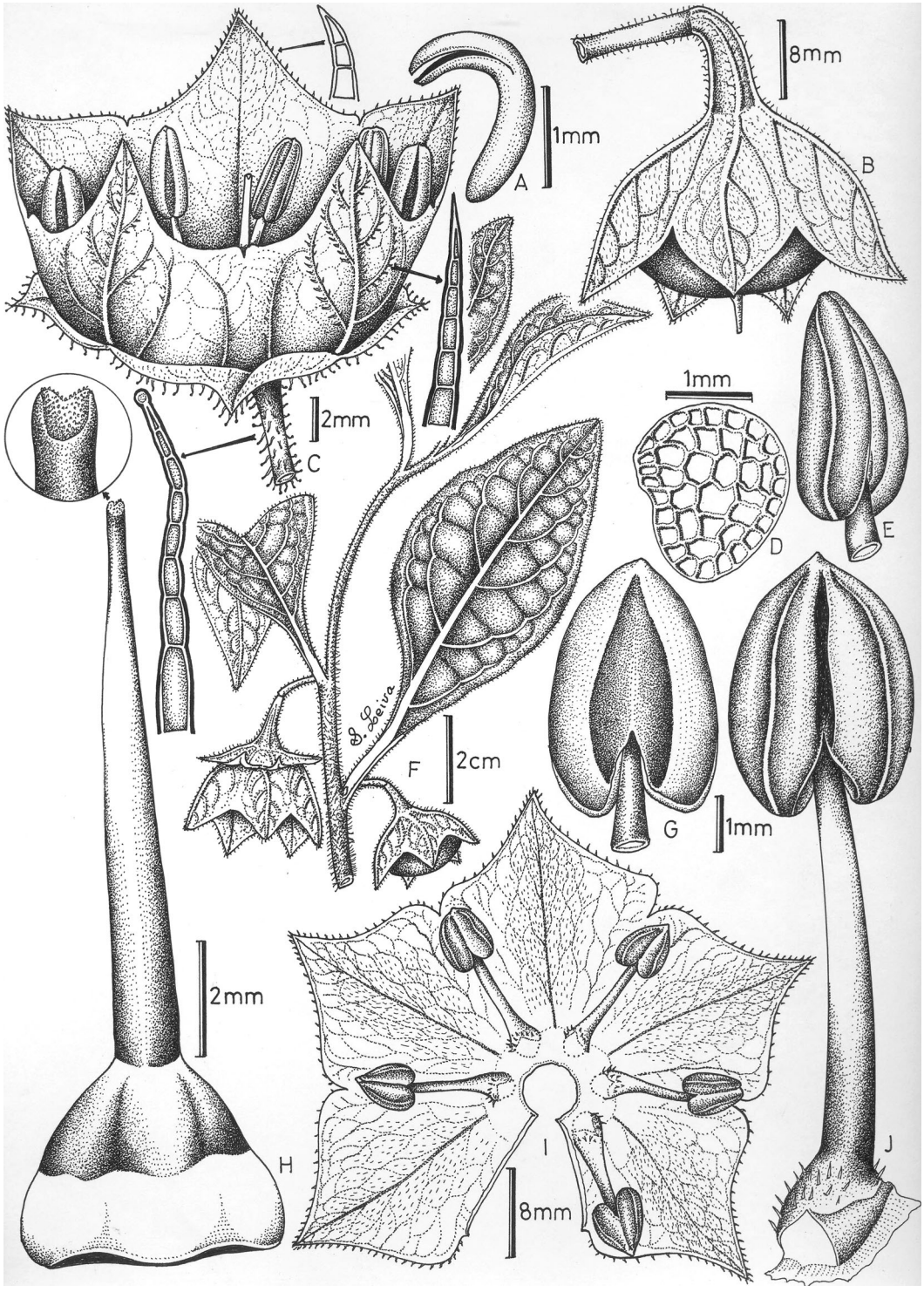

FIG. 3. *Jaltomata quipuscoae.* **A.** Embryo. **B.** Berry with calyx, side view. **C.** Flower, side view, with hairs expanded. **D.** Seed. **E.** Anther, lateral view. **F.** Branch with leaves flowers and fruit. **G.** Anther, dorsal view. **H.** Gynoecium including basal disk. **I.** Corolla dissected to show the insertion of the stamens. **J.** Stamen, ventral view. (From *S. Leiva G. et al. 4654*).

entire, ciliate; petiole to 3.5 cm long. Flowers solitary (Fig. 3F); peduncle to 9 mm long, terete; pedicel to 10 mm long, 5-sided or subterete, both pedicel and peduncle green to purple and densely pubescent, the hairs gland-tipped. Calyx during anthesis: green, planar, sepals 14–15 mm long, the lobes triangular, abaxially densely pubescent with gland-tipped finger hairs; calyx with fruit: green, infundibular, hiding berry in side view, and to 25 mm across. Corolla broadly crateriform (Fig. 2C, E), 5-lobed, lacking lobules, to 3.3 cm diameter, purple with green ring at the base, the inner surface puberulent with hairs 0.06 mm long, the hairs of the outer surface concentrated on veins, the margin ciliate. Nectar copious, red to purple, pooling on corona. Stamens 5, 13 mm long, not exserted beyond the distal end of the corolla, the filaments dark purple proximally fading to light purple distally, nearly glabrous but having a few short (0.25 mm long) finger hairs at the base, the base of the filament appressed to the ovarian disk; anthers yellow prior to dehiscence, 3.4 mm long (dehsiced, pressed), basifixed, emucronate, those of a flower dehiscing asynchronously; pollen grains 25–27.5 μm (mean 25.5) diameter. Stigma punctiform (Fig. 3H), not bilobed, darker green than the style; style straight, pale-green, 1 cm long, widest at base and gradually narrowing toward apex; ovary pale-green, 3 mm wide × 2.8 mm high, the disk one-third as high as the ovary. Berries whitish to pale-green at maturity, 15–18 mm across, hidden by the calyx in side-view (Fig. 2D).

Additional specimens examined. PERU. Arequipa: Prov. Arequipa, Dist. Yarabamba, alrededores de los Petroglifos de Sogay, 16° 33' 58.6" S, 71° 25' 40.6" W, 2607 m, 7 Jan 2010, *S. Leiva G. et al. 4654* (HAO), *Mione et al. 797* (*798* seeds only) (HUSA). Prov. Caraveli, km 586 Panamericana Sur, 6 km north of Atiquipa turnoff on Panamerican Highway, 300–860 m, 3 Oct 1997, *M. Weigend & H. Förther 97/701* (M).

Jaltomata quipuscoae and the other two species of *J.* section *Modillonia* (Leiva González et al., 2010) share the following characters: they are endemic to Peru, they are herbaceous and have solitary flowers with a 5-lobed corolla, a corona (a structure on which nectar pools), basifixed anthers (the filament is inserted on the lower ventral face of the anther in other sections of this genus), and a stigma no wider than the top of the style (punctiform, not capitate). They also produce copious red-orange nectar, and the fruits are green to whitish (except for one report of orange fruits in *J. aspera*, Table II). *Jaltomata quipuscoae* was not included in the recent molecular phylogeny of *Jaltomata* (Miller et al., 2011). However, the other two species of section *Modillonia* are together monophyletic in both the strict consensus tree and the majority-rule consensus tree.

The three species of *Jaltomata* section *Modillonia* (Table II) individually have narrow allopatric distributions but together are widely distributed in Peru: *J. aspera* (Ruiz & Pav.) Mione grows almost exclusively in the Department Lima (Mione & Coe, 1992), *J. calliantha* S. Leiva & Mione grows in the Department La Libertad (Leiva Gonzales et al., 2010), and *J. quipuscoae* (here described) grows in the Department Arequipa.

The Weigend & Förther specimen (97/701, M) was identified by T. M. as *Jaltomata quipuscoae* based on morphological characteristics, but was collected in a different habitat (lomas) some 2000 m lower than the other collections, in west-facing sandy and rocky slopes. Similarly, *J. aspera*

TABLE II
COMPARISON OF ALL *JALTOMATA* SPECIES HAVING A FLORAL CORONA.

	J. aspera	*J. calliantha*	*J. quipuscoae*
Corolla color	greenish-yellow or yellow-green	green	purple
Ring of green at base of corolla	no	yes	yes
Filament color	whitish to pale yellowish	purple	purple
Base of filament	pubescent	glabrous	nearly glabrous
Mature fruit color	white (Macbride, 1962); orange (*A. Granda 926*, MOL)	very pale-green	whitish to pale-green
Elevation m	Lomas: 150–600. Andes: 1600–2550.	Andes: 1420–1870.	Lomas 300–860. Andes: 2607–2625.
Distribution (Peruvian Departments)	Primarily Lima	La Libertad	Arequipa

grows both in the lomas habitat and the Andes (Mione & Coe, 1992). Andean populations and lomas populations of both *J. aspera* and *J. quipuscoae* flower during different months of the year: in the lomas habitat flowering occurs August through October; however in the Andes, flowering occurs January through early May. Lomas and Andean populations of these species are thus apparently reproductively isolated, and additional study may reveal that Andean and lomas populations within each species as here circumscribed are actually sibling species.

Both *Jaltomata neei* and *J. quipuscoae* are protogynous; in the field we saw at the same time open flowers having undehisced anthers and other flowers having dehisced anthers. Protogyny is widespread in the genus *Jaltomata*.

The name of this species was chosen to honor Victor Quipuscoa Silvestre, discoverer of this species.

Acknowledgments

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