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The *Jaltomata* (Solanaceae) of Department Lima, PeruThomas Mione^{1*}, Segundo Leiva González², Leon Yacher³¹Professor (PhD), Biology Department, Central Connecticut State University, New Britain, CT 06050-4010.²Director (Maestría en Botánica Tropical), Museo de Historia Natural, Universidad Privada Antenor Orrego, Avenida América Sur 3145, Trujillo, Perú.³Professor (PhD), Department of the Environment, Geography & Marine Sciences, Southern Connecticut State University, New Haven, CT 06515-1355.***Corresponding Author:**

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Abstract: Discoveries of new-to-science species have rendered outdated the last published list of *Jaltomata* species of Peru. We recognize eight *Jaltomata* species in Department Lima: *J. andersonii*, *J. aspera*, *J. bicolor*, *J. contorta*, *J. dentata*, *J. hunzikeri*, *J. propinqua*, *J. umbellata*, and *J. sinuosa*. The latter has not been collected in Department Lima but was included in the key because it is likely to grow in Department Lima. Fruits of at least five of these species (*J. aspera*, *J. bicolor*, *J. dentata*, *J. propinqua*, *J. umbellata*) are eaten by people. Two species, *J. aspera* and *J. umbellata*, have copious red/orange floral nectar. In *lomas* communities *J. aspera*, *J. hunzikeri* and *J. umbellata* flower July–October. However, in the Andes *J. aspera*, *J. bicolor*, *J. dentata* and *J. propinqua* flower mostly from December–April. There are no recent collections of *J. contorta* and *J. hunzikeri* and these species may be extinct.

Keywords: biodiversity, extirpation, *Jaltomata*, *lomas*, red nectar, Solanaceae.

INTRODUCTION

Jaltomata is a diverse genus of approximately 68 species, of the Solanaceae. Flowers range from rotate to tubular (Figure 1), from less than 1 cm to 6 cm across, and with 1–41 flowers per inflorescence. Habitats range from full sun in the desert [1] to shaded trail edges in the rainforest. Species occur from near sea level to over 4100 m, and are distributed from Arizona, USA to Bolivia and grow on both the Galápagos and Greater Antilles Islands. The fruit, a berry, is fleshy, and orange (Figure 1E), red, purple/black or green. Berries of at least 40 *Jaltomata* species are eaten by people [2]. Bees and hummingbirds have been seen visiting the flowers of different species [3], and among species the nectar color ranges from transparent to blood-red [4, 5]. Both widespread species and narrow endemics are known. For example *J. repandidentata* (Dunal) Hunz. grows from Mexico to Bolivia [6] but *J. atiquipa* Mione & S. Leiva is known only from the coast of Peru (in a *lomas* community, which receives all of its moisture from fog) [7]. *Jaltomata* is of interest for studies of ethnobotany [8, 9], floral biology and colored nectar [10, 11], seed germination [12], biogeography [13], phylogeny [14, 15], taxonomy [1, 16–19], ecological genomics [20], and the genetic basis of morphological evolution [21].

The Department of Lima, Peru has likely been botanically explored more extensively than any other of Peru's 24 Departments, in part because the city of Lima

has been the port of entry for botanists for centuries. The earliest botanists arrived by ship [22] and in more recent times Lima's Jorge Chavez International Airport has been the primary place of disembarkation for foreign botanists. And with several major universities, the city of Lima has served as the place of employment and home of many Peruvian botanists who have contributed, and continue to contribute, to botanical exploration. After two decades of study we are confident in our understanding of the *Jaltomata* species of Department Lima, and present a key to the species of this Department and a table including synonyms and morphological characteristics. Discoveries have rendered outdated the last published listing of the *Jaltomata* species of Peru [23].

MATERIALS AND METHODS

For taxonomic study the authors collected specimens of the genus *Jaltomata* in Peru in 1998, 1999, 2005, 2007, 2008, 2010, 2011, 2013, 2015 and 2016. Specimens have been deposited at CONN and HAO. For this study, herbarium specimens were borrowed from CONN, F, G, GH, K, M, MA, MO, NY, P, US, VT and WIS [24].

RESULTS

Eight *Jaltomata* species grow or have grown in Department Lima, Peru (Figure 1, Table 1). And *J. sinuosa* is included in the keys even though it has not been collected in Department Lima because it is

common in Peru to the north, east and south of Department Lima and thus there is a reasonable chance that it grows in Department Lima.

DISCUSSION

Throughout the range of *Jaltomata* the berries of at least 40 species are eaten by people [2], and in Department Lima the fruits of at least five species are eaten by people (Table 1). In general, people consume the berries when they find them ripe in the wild; we have not seen berries of *Jaltomata* species for sale.

Lomas communities are virtual islands that are high in endemics and are surrounded by hyper-arid desert [13]. *Lomas* communities, although devoid of rain, receive moisture from fog that comes off the sea [13]. Three of the *Jaltomata* species of Department Lima (*J. aspera*, *J. hunzikeri*, *J. umbellata*) grow or grew in *lomas*. In the *lomas* community *Jaltomata* species flower July through October when fog from the sea provides moisture. However, in the Andes (*J. aspera*, *J. bicolor*, *J. dentata*, *J. propinqua*) flowering occurs mostly December through April. This renders populations of *J. aspera* of the Andes and the *lomas* community temporally isolated.

In the Department of Lima *Jaltomata aspera* and *J. umbellata* produce copious red-orange nectar and both grow in the *lomas* community. A diverse subset of additional *Jaltomata* species, mostly growing at high elevations, produces red/orange nectar [11].

During fieldwork, we were unable to find living plants of *Jaltomata hunzikeri* at or near the type locality or anywhere else; rather, we found human settlement where the type specimen was collected in 1938 [25], and thus there is the possibility that *J. hunzikeri* has gone extinct due to expansion of human settlement. Similarly, one of us (L. Y.) went to Amancaes (now an outskirts of the city of Lima) in February of 2014, where both *J. aspera* and *J. umbellata* have been collected, and noted expansion of human settlement into the *lomas* community there. *Jaltomata* was not encountered during collecting for a recent vascular flora of Amancaes [26]. And so *J. aspera* and *J. umbellata* are likely extirpated from Amancaes. Given that *lomas* communities are near the sea, and humans disproportionately settle near the sea, *lomas* communities are heavily impacted by humans. *Jaltomata* is not alone: extirpation of several other species from the *lomas* community at Amancaes has been documented [26].

According to Ruiz & Pavon's protologue [27], *Jaltomata contorta* was first collected in Department Lima, province Canta, near Obrajillo in 1788, and was described from plants cultivated in the Madrid Royal Botanic Garden [28]. Graciela Vilcapoma Segovia, a botanist and long-time resident of Department Lima, told T. M. in 2005 [29] that she searched Obrajillo,

knowing the area intimately, and never found this species. Furthermore, we were unable to find this species growing at or near the type locality nor anywhere else. Several *Jaltomata* species were originally described in the genus *Saracha* (Table 1) and have since been formally transferred to *Jaltomata*: the type specimen of *S. diffusa* Miers, collected in Department Lima, province Canta, appears to be conspecific with *J. contorta*. If so, *J. contorta* is known from at least two specimens. On the type specimens of *S. diffusa* Miers (Ann. Mag. Nat. Hist. ser. 2, 3: 447. 1849; Miers, Ill. S. Am. Plants 2: 17–18. 1849–1857; Mathews 775, Type: K!, F!; Isolectotype: W, F neg. 33016) (not *Saracha diffusa* Miers, Ann. Mag. Nat. Hist. ser. 2, 3: 451. 1849 [= *S. miersii* Dunal & A. DC., Prodr. 13(2): 684. 1852], Type: Mexico, Galeotti 1169 K!, P!) the collection locality is given as “Cuesta de Puruchua.” However, in the protologue Miers gave the type locality as “Cuesta de Puruchuco” and Morton [30] gave the spelling as Purrochuco. We give the type locality as “Puruchuco,” as did Macbride [31], a small town in Peru, Department Lima, province of Canta, at 11 33' S, 76 48' W and 2500 m elevation. According to Arturo Granda Paucar [32] Cuesta de Puruchuco is a subxerophytic steep slope within a few hundred meters below the town, but it is possible that Mathews regarded the higher hills near Puruchuco on the way to the town of Huamantanga as the Cuesta de Puruchuco. *Sarachadiffusa* Miers based on Mathews 775 is here considered a synonym of *J. contorta*. *Jaltomata repandidentata* grows in Departments north, east and south of Department Lima, and is similar to *J. contorta*; both are herbaceous, have rotate corollas and black/purple fruits. However, *J. repandidentata* differs from *J. contorta* by having a curved style and anthers of a flower varying in size, and thus we are certain that the two collections of *J. contorta* are not actually *J. repandidentata*.

The department of Ancash borders the Department of Lima to the north. The Department of Lima has eight species (at least four endemic) while the Department of Ancash has at least 11 species. Only two species are shared by both Departments: We discovered *J. andersonii* in the Department of Lima [33] and as such, its type locality is in Department Lima, and a single specimen of *J. andersonii* (M. Weigend & N. Dostert 97/173, F) has been tentatively identified from southeastern Department Ancash, but differs somewhat from the type collection and confirmation through fieldwork is needed. We confirmed through fieldwork in 1998, 2015 and 2016 that *J. propinqua* grows both in the Departments of Lima and Ancash. Considering the final stamen length (after anther dehiscence), populations from Department Lima have a style nearly twice the length of the stamens while populations from Department Ancash have styles that vary in length within a population, ranging from a few mm longer than the stamens to nearly twice the length of the stamens. *Jaltomata sinuosa* is a common species, and has been

collected in Departments north, east and south of Department Lima [34], but not to our knowledge in Department Lima. We include it in our key because there is a reasonable chance that *J. sinuosa* grows in the Department of Lima.

CONCLUSION

A key is presented to the *Jaltomata* species that grow, likely grown, or grew in Department Lima, Peru. Two species, *J. aspera* and *J. umbellata*, have copious

red/orange floral nectar. *Jaltomata aspera*, *J. hunzikeri* and *J. umbellata* have been collected in lomas communities, virtual islands high in endemics that are surrounded by hyper-arid desert, and although devoid of rain, receive moisture from fog that comes off the sea. There are no recent collections of *J. contorta* and *J. hunzikeri* and these species may be extinct. Fruits of at least five species (*J. aspera*, *J. bicolor*, *J. dentata*, *J. propinqua*, *J. umbellata*) are eaten by people.

Key to the *Jaltomata* of Department Lima, Peru:

1. Flowers solitary.....2
1. Two to more flowers per inflorescence.....3
2. Floral corona present; filaments glabrous or sparsely pubescent at base; nectar red; hairs not gland-tipped.....*J. aspera*
2. Floral corona absent; filaments extremely villous at base; nectar transparent; hairs gland-tipped.....*J. andersonii*
3. Plants woody; fruit orange at maturity 4
3. Plants herbaceous; fruit black/purple at maturity*J. contorta*
4. Corolla purple; nectar transparent; Andes5
4. Corolla pale-green or white, lomas habitat8
5. Stamens longer than 6 mm; corolla lobes and lobules alternating, totaling 106
5. Stamens shorter than 6 mm; corolla 5-lobed, no lobules.....*J. dentata*
6. Style about twice as long as stamens*J. propinqua*
6. Style about the length of stamens7
7. Corolla urceolate-tubular; stamens 26–35 mm long*J. bicolor*
7. Corolla rotate; stamens 10 mm*J. sinuosa*
8. Stamens 9–11 mm long; nectar red/orange *J. umbellata*
8. Stamens 4.5–7 mm; nectar transparent or nearly so*J. hunzikeri*

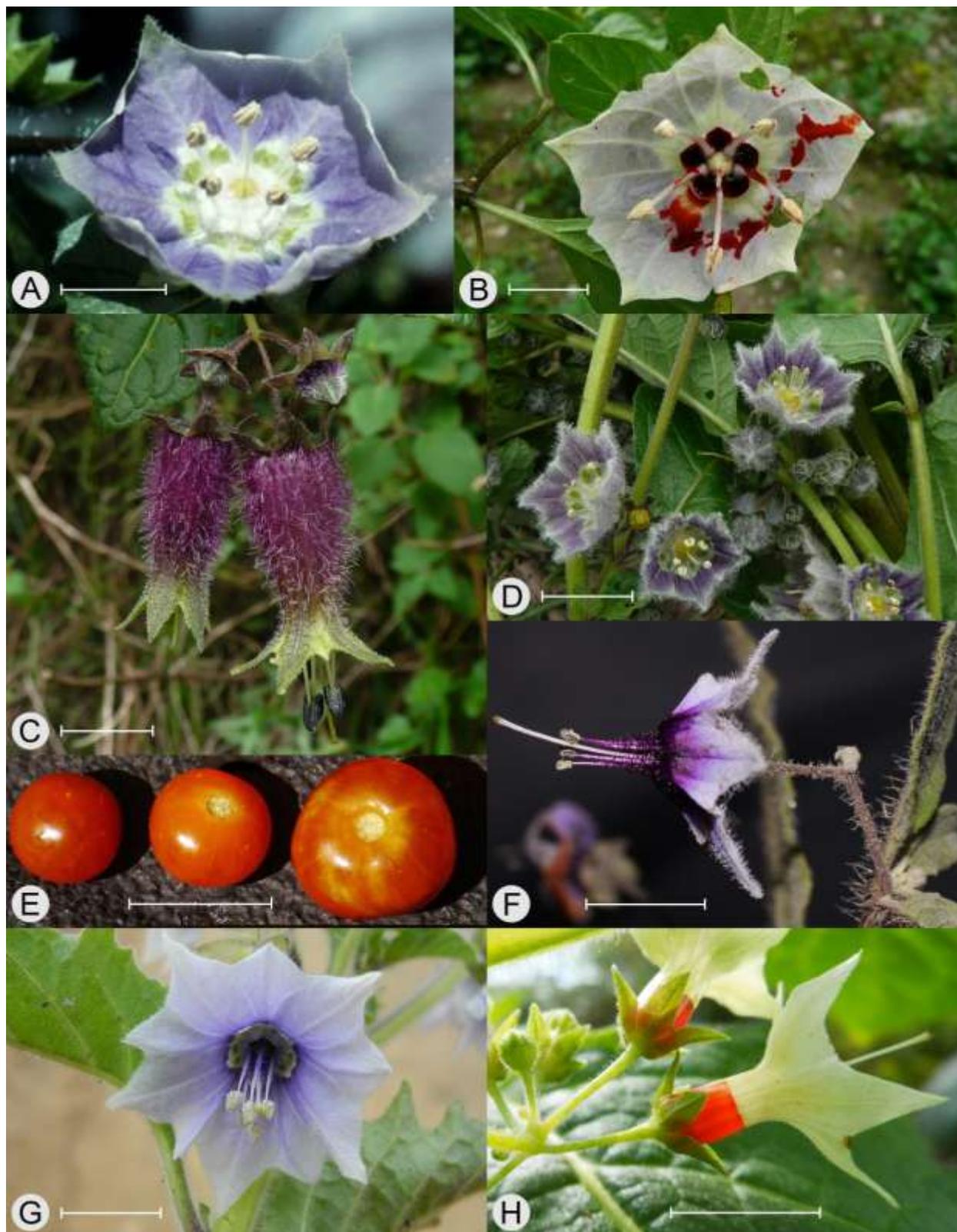


Fig-1: A—*Jaltomata andersonii*, flower, photo by T. M. B—*J. aspera*, flower, corona appears as a raised ridge of tissue around each of the five nectar troughs, photo by S. L. G. C—*J. bicolor*, flowers in longitudinal view: the flower on the left's lack of exertion of stamens shows that it is younger than the flower at the right, photo by S. L. G. D—*J. dentata*, leaves and flowers: the flower in the center has two dehiscent anthers and three undehiscent anthers showing that anthers of a flower do not dehisce simultaneously, photo by S. L. G. E— Ripe fruits of *J. dentata*, photo by T. M. F— *J. propinqua*, flower, photo by T. M. G—*J. sinuosa*, flower, photo by T. M. H—*J. umbellata*, flower with red nectar showing through the wall of the corolla, photo by Jamie Kostyun. All scale bars equal one cm.

Table 1. The *Jaltomata* species of Peru, Department Lima.

	<i>J. contorta</i> (R. & P.) Mione	<i>J. andersonii</i> Mione	<i>J. aspera</i> (R. & P.) Mione	<i>J. bicolor</i> (R. & P.) Mione	<i>J. dentata</i> (R. & P.) Benítez	<i>J. propinqua</i> (Miers) Mione & M. Nee	<i>J. sinuosa</i> (Miers) Mione	<i>J. umbellata</i> (R. & P.) Mione & M. Nee	<i>J. hunzikeri</i> Mione
Figure	none	1A	1B	1C	1D	1F	1G	1H	none
Elevation (m)	2732	2300–3400	200–2290	2945–3820	2600–3600	2000–3000	1700–3500	300–500	80–300
Habit	herbaceous	herbaceous	herbaceous to suffrutescent	shrub	woody at base, herbaceous above	shrub	shrub	shrub	shrub
Plant height (m)	0.6*	0.2	0.2–0.6	0.5–1.5 (–3)	0.2–0.5 (–0.7)	–1.2	–1.2	–1.3	–1
Hairs of young stems, and leaves	glabrous*	stems pilose, leaves sparsely, the hairs long	stems pubescent, leaves pubescent to glabrate, the hairs short	glabrate to sparsely pubescent	pubescent, the hairs short	pilose, the hairs long	pilose, the hairs long	pilose, the hairs long	villous, the hairs long
Hairs mostly gland- tipped?	not applicable	yes	no	no	no	yes	yes	yes	yes
Flowers per inflorescence	6–10	1	1	2–4	2–many	4–7 (–10)	2–4	4–9	–10
Both pedicel and peduncle?	yes	no , single unarticulated axis	yes	yes	yes, but peduncle absent on parts of some specimens	yes	yes	yes	yes
Corolla shape	rotate	broadly crateriform- rotate	broadly crateriform- rotate	urceolate-tubular	crateriform	short-tubular with a reflexed limb	rotate with a recessed area holding nectar	tubular with a somewhat planar limb	probably short- tubular with a somewhat planar limb
Number of									

corolla lobes / lobules	5 / 0 *	5 / 0	5 / 0	5 / 5	5 / 0	5 / 5	5 / 5	5 / 0	5 / 0
Corolla size (mm)	12 across	-37 across	-42 across	-30 long	-15 across	the tube 3-4 long, the limb 19 - 27 across	-33 across	the tube 6.5-8 long, the limb 14-23 across	the limb 16-17 across
Corolla color	whitish-yellow *	purple	pale-green	purple proximal 2/3, pale-green to cream distal 1/3	purple to whitish	purple	purple at center fading toward periphery	pale-green, with red nectar showing through the corolla	white with a blue ring near end of tube
Corolla having 5 pairs of green spots	probably yes	yes	no	no	yes	no data	yes	no	no data
Stamen length (mm)	no data	6.9-7.2	12-14	26-35	3-4	8-13	11	9.2-10.9	4.8-7
Anther color	no data	drying brown	cream or yellow or pale green	blue to purple	yellow	blue to purple	cream to pale-yellow with purple along sides and bottom	yellow	no data
Nectar color	no data, almost certainly clear	clear	red	clear	clear	clear	clear	red	no data, probably clear
Fruit color	black*	no data, probably orange	very pale green; described as orange on one specimen label	orange	orange	orange	orange	orange	no data, probably orange
Fruits eaten? Page number in [35]	no data	no data	yes	yes 49	yes 57	yes 70	yes 74	yes 77	no data
Months in	possibly	Jan.-Mar.	Sep.-Oct. in	Nov. -July	Dec.-Apr. and	Nov.-June	Dec.-Sep.	July-Oct.,	Sep.

flower	flowering at the date of collection 3–7 Feb.		<i>lomas</i> ; Jan., Mar., Apr. in Andes		one specimen was collected in Aug.			Jan.	
Endemic to Department Lima?	yes	no: one specimen is known from Dept. Ancash	yes	yes	no if <i>Weberbauer 7602</i> (GH, NY, US) of Dept. Huancavelica is conspecific.	no	no	yes	yes
Common, rare?	rare or extinct, see text for details	apparently rare	not common	common	common	not rare, possibly common	common	rare	rare or extinct, see text for details
Synonyms and page number(s) in [31]	<i>Saracha contorta</i> R. & P., p. 32; <i>S. diffusa</i> Miers based on Mathews 775, p. 34.	none	<i>Saracha ciliata</i> Miers, p. 32; <i>S. lacrima-virginis</i> Bitter, p. 32; <i>S. urbaniana</i> Bitter & Dammer, p. 38; <i>Hebecladus asperus</i> (R. & P.) Miers, p. 30.	<i>Hebecladus bicolor</i> (R. & P.) Miers, p. 30; <i>Atropa biflora</i> R. & P., p. 30; <i>H. intermedius</i> Miers, p. 35.	<i>Saracha dentata</i> R. & P., p. 33; <i>S. lobata</i> Bitter, p. 35; <i>S. sordideviolacea</i> Bitter, p. 37.	<i>Saracha propinqua</i> Miers, p. 36; <i>Hebecladus propinquus</i> (Miers) Bitter, p. 36.	See [25] for a complete list of synonyms. Not listed by [31].	<i>Hebecladus umbellatus</i> (R. & P.) Miers, p. 37; <i>H. turneri</i> Miers, p. 38.	The type specimen of <i>J. hunzikeri</i> was listed as <i>Saracha villosa</i> (Zucc.) G. Don[31, p. 40]but this binomial is not a synonym [25].
Authors' collection numbers	none	616, 620, 622	615	612, 617, 795, 880	609, 610, 611, 613, 618, 881	621, 868	668, 672, 677, 708, 733, 736, 815, 848, 849, 851, 852, 877–879	432, 623, 730	none

* according to the protologue

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