Itoa orientalis

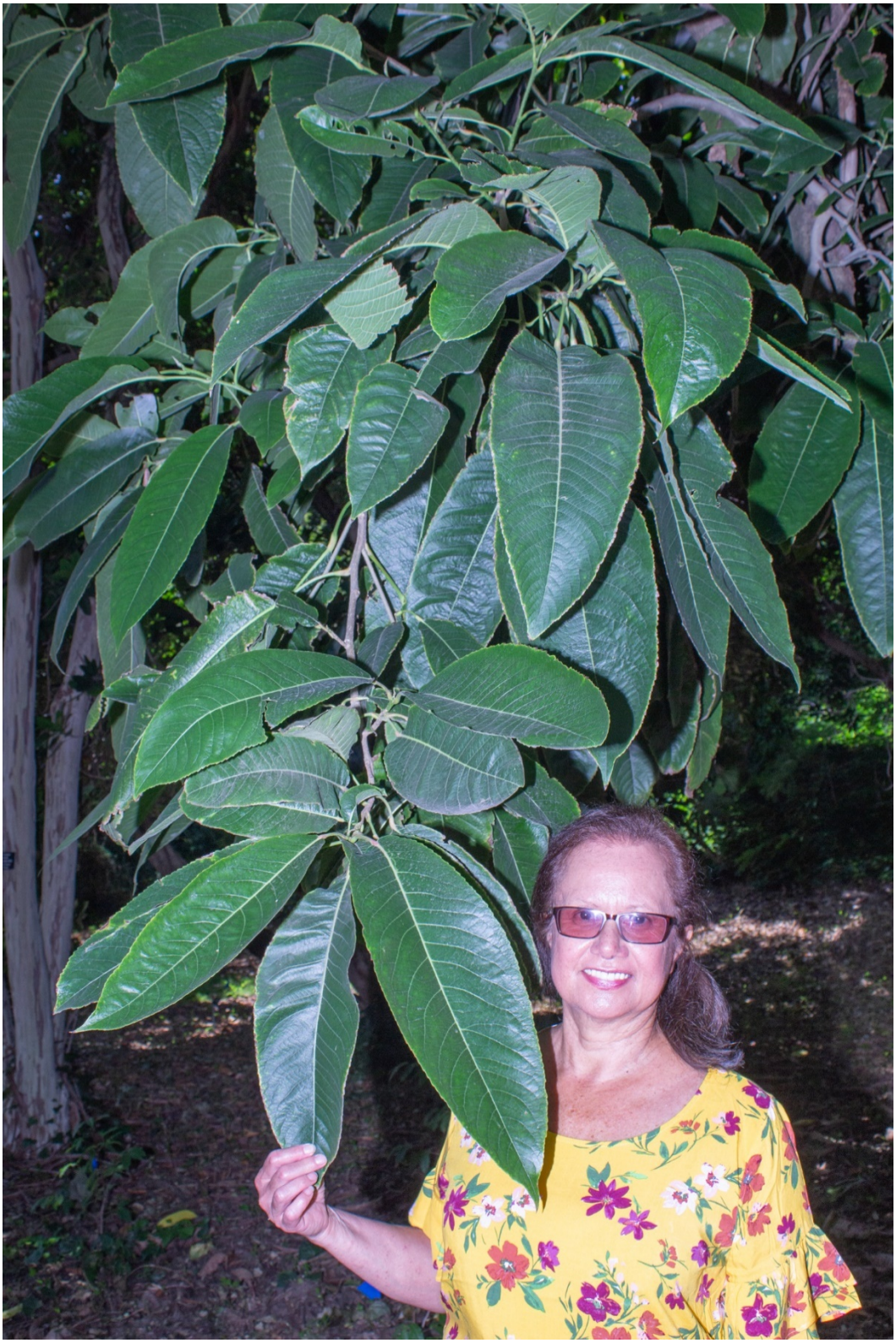
DONALD R. HODEL AND JAMES E. HENRICH

A little more than five years ago we were in the Asia section of the Los Angeles County Arboretum and Botanic Garden in Arcadia, California and we happened upon a most intriguing, big-leaved, evergreen tree. The dark green, exceptionally large leaves, nearly 50 cm long and 15 cm wide, lending an appealing tropical motif to the tree immediately attracted Hodel's attention (**Fig. 1**). Looking around, we found staminate and pistillate flowers, both rather unusual, the staminate in their numerous stamens and the pistillate in their remarkable gynoecium with very short styles and palmately branched, irregularly lobed, tortuous, somewhat flattened, spreading stigmas reflexed against the rounded ovary and looking like growths of greenish yellow coral (**Fig. 2**). We found remnants of a few old fruits, which were equally intriguing in the zigzag nature of their persistent, woody pericarps (**Fig. 3**). Hodel also appreciated the habit of the tree, large and upright, with a mostly straight trunk covered with light gray to nearly cream-colored bark, a strikingly handsome contrast to the dark green leaves.

Altogether, Hodel was thoroughly smitten with this curious and handsome tree, so much so that he often visited it during his frequent sojourns to the Arboretum and slowly but steadily amassed a good deal of information about its history, taxonomy, and horticulture, which we share here.

History

William Botting Hemsley (1843–1924), an English botanist and 1909 recipient of the Victoria Medal of Honour, who authored a number of botanical papers covering a wide swath of the world, from Asia to the Americas, named and described the genus *Itoa* and the species *I. orientalis* in 1901, basing them on two collections that Augustine Henry had made in Mengzi, Yunnan, China (Hemsley 1901). Henry (1857–1930), a British-born Irish plantsman and sinologist, was a prolific plant collector in China in the late 19th century, sending over 15,000 dried specimens and seeds to the Royal Botanic Gardens at Kew, England (Nelson 2000). Many consider his contributions of Chinese plants to the western world to rival those of the later and better known plant collectors Ernest Wilson and Frank Kingdon-Ward. Indeed, John W. Besant (1878–1948) of the Royal Botanic Gardens, Kew, wrote, "The wealth of beautiful trees and flowering shrubs which adorn gardens in all temperate parts of the world today is due in great measure to the pioneer work of the late Professor Henry." (Besant 1935).



1. Marianne Hodel provides scale for the striking, exceedingly large, tropical-looking leaves of *Itoa orientalis* at the Arboretum (*1978-0401-S*1*).

2–3. Pistillate flowers (left) of *Itoa orientalis* are remarkable in their palmately branched, irregularly lobed, tortuous, spreading stigmas looking like growths of greenish yellow coral and their curious zigzag fruit remnants (*1978-0401-S*1*).

In naming *Itoa*, Hemsley (1901) honored and based the genus name on Dr. Keisuké Ito (1803–1901), one of the pioneers of modern Japanese botany, and his grandson Dr. Tokutaro Ito (1868–1941). The elder Ito, a pupil of the famous plantsman and scholar of the Japanese flora, Philipp Franz von Siebold (1796–1866), was devoted to philanthropic and scientific work and his countrymen honored and selected him as one of "The Twelve Heroes of Modern Japan." A finely rendered drawing of a leaf, staminate flowers, and inflorescence, pistillate flowers, a fruit, and seeds supplements Hemsley's description of *Itoa* and *I. orientalis*.

Taxonomy

Itoa Hemsl. in Hooker's Icones Plantarum 27: pl. 2688. 1901. Type species: *I. orientalis* Hemsl.

Mesaulosperma Slooten

Itoa are evergreen, mostly large and dioecious, simple-leaved, forest trees. Originally placed in the Flacourtiaceae (Sleumer 1954), molecular and other evidence have mostly subsumed this

family and *Itoa* into the Salicaceae (Stevens 2017). *Itoa* have large, alternate or spirally arranged, sometimes subopposite leaves with early caducous stipules. The long petioles lack glands, although they are swollen somewhat proximally and especially so distally, and the pinnately nerved blade has glandular, toothed margins. Flowers are unisexual, hypogynous, the staminate are held in many-flowered, erect, terminal panicles while the pistillate are solitary or in few-flowered terminal or axillary racemes. Inflorescence bracts are present, and bracteoles are one pair per pedicel. Sepals, which appear 3- or 4-merous in bud but are actually 5-merous at anthesis, are ovate, valvate, free, and thick. Petals are lacking. Staminate flowers have numerous stamens, typically over 100, about half the length of the calyx, with free, filiform filaments and ellipsoid to oblong, basifixed anthers, and a short, squat pistillode. Pistillate flowers have a superior, 1-loculed ovary with 6–8 , rarely 5, filiform, woody, persistent placentas, 6–8, very short, connate styles forming a short longitudinally ribbed column, (4–)6–8, spreading or strongly reflexed, irregularly palmately lobed stigma branches, and numerous staminodes appearing like much reduced stamens. The large, ovoid or ellipsoid, tomentose fruit is a capsule with a finely dehiscent pericarp and 6–8, rarely 5, fusiform valves that split from apex and base and remain attached by persistent, woody placental strips. The small, ellipsoid, numerous, compressed, vertically arranged seeds are each surrounded by a relatively large, broad, flat, membranous, irregularly triangular wing.

Itoa comprises two, closely allied species, *I. orientalis*, treated here, and *I. stapfii*, not growing at the Arboretum and not treated here. The latter is a large, buttressed, tropical tree to 40 m tall from mixed, moist to wet, primary and secondary forests in Indonesia (Celebes, Moluccas, and New Guinea) (Sleumer 1954). Although the differences between the two are somewhat vague (Sleumer 1954), they can be distinguished as follows:

Leaf blades 13–50 cm long, 10–26-nerved; seed wings to 2 cm long, seed 3 mm long . . . . . *I. orientalis*

Leaf blades 10–15 cm long, 10–13 nerved; seed wings 3.5–4 cm long, seed 6 mm long . . . . . *I. stapfii*

Itoa orientalis Hemsl. in Hooker's Icones Plantarum 27 (or Vol. 7, Pt. 1): pl. 2688. 1901. Type: China, Yunnan, Mengtzu (Mengzi), 5,000 feet, *A. Henry 9408* (lectotype, designated here: K-000591301; isolectotypes K-000591302, MO-5714088, MO-5714089).

Carrierea vieillardii Gagnep., Notul. Syst. (Paris) 3: 368. 1918. Type: Vietnam, Tonkin, Cha-pa áMuong-xen, *Lecomte & Finet 449* (holotype P).

Mesaulosperma vieillardii (Gagnep.) Slooten, Bull. Jard. Bot. Buitenzorg, sér. 3, 7: 384. 1925.

4. Liz Mendoza provides scale for *Itoa orientalis* at the Arboretum. (*1978-0401-S*1*).

5–6. Marianne Hodel stands next to a multi-trunked *Itoa orientalis* at the Arboretum. Its main trunk is straight and erect. (*1978-0401-S*1*).

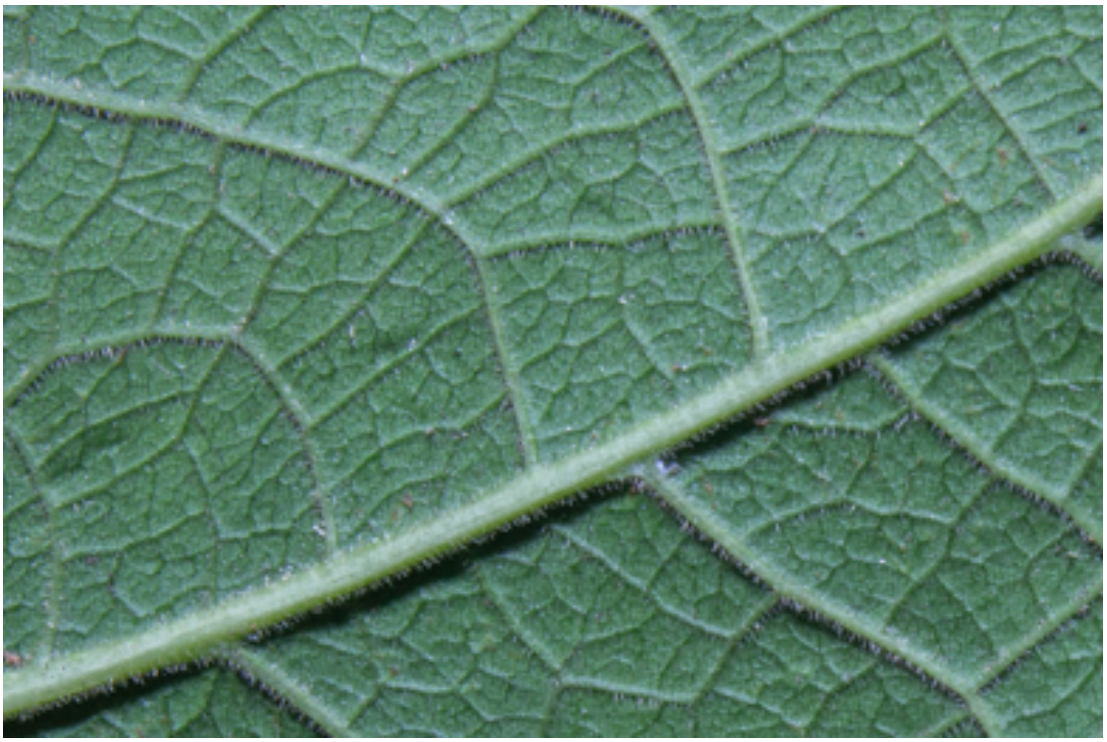
7–8. *Itoa orientalis* has light gray bark with faint, tan, vertical lines and twigs with conspicuous, white lenticels. (*1978-0401-S*1*).

9. Leaves of *Itoa orientalis* are mostly alternate, sometimes subopposite or clustered at the branch tips. (*1978-0401-S*1*).

10. Petioles of *Itoa orientalis* are distinctly swollen and pink proximally and especially so distally.

11. Leaves of Itoa orientalis can be large and are simple and dark glossy green adaxially. (*1978-0401-S*1*).

12. Leaves of Itoa orientalis are pale green on the abaxial surface and with conspicuous primary nerves. (*1978-0401-S*1*).



13. The leaves of *Itoa orientalis* have short, stiff, dense hairs on the abaxial surface, especially along the nerves. (*1978-0401-S*1*).

14. Staminate inflorescences of *Itoa orientalis* are terminal and many flowered. (*1978-0401-S*2*).

15. Staminate inflorescences of *Itoa orientalis* are terminal and many flowered. Note the calyx initially opening by lateral slits between the sepals and the yellow stamens. (*1978-0401-S*2*).

16. Pistillate inflorescences of *Itoa orientalis* are few- or single-flowered. (*1978-0401-S*1*).

17. Pistillate (left) and staminate flowers of *Itoa orientalis* lack petals but have greenish, thick, fleshy sepals. Note the highly branched stigmas and hairy ovary of the pistillate flower and the numerous stamens of the staminate flowers.

栀子皮 *zhi zi pi*

Habit: evergreen, mostly dioecious, medium to large, upright, forest tree to 20 m tall (**Fig. 4**).

Trunk: mostly solitary, in cultivation sometimes multi-trunked with 2 to 4 trunks arising from the base or nearly so, straight, erect (**Figs. 5–6**); bark smooth, light gray to cream-colored with faint, vertical, tan lines (**Fig. 7**); twigs green, densely pubescent, lenticels conspicuous, white; branchlets greenish, glabrescent, lenticels conspicuous, white (**Fig. 8**)

Leaves: mostly alternate, sometimes subopposite or clustered at the branch tips (**Fig. 9**); petiole 2–6 cm long, pubescent or glabrous, slightly swollen proximally and with a pink blush, conspicuously swollen and pinkish distally (**Fig. 10**); blades 13–30(–50) × 6–18 cm, narrowly to broadly elliptic, oblong-elliptic or ovate, dark green adaxially (**Fig. 11**), initially pubescent especially along midrib and primary nerves but becoming glabrous, pale green abaxially (**Fig. 12**) and densely pubescent with spreading hairs to 0.5 mm long (**Fig. 13**), or glabrous, midrib raised abaxially, slightly impressed adaxially, primary nerves 10–26 pairs, apex and base obtuse to rounded, apex abruptly contracted into a short acumen, or apiculate, rarely acute, margins serrate to serrulate, teeth obtuse.

Inflorescences: staminate terminal, many-flowered panicles (**Figs. 14–15, 18**), pistillate few- or single-flowered terminal or axillary racemes (**Figs. 16**); peduncle, rachises, pedicels, and abaxial surfaces of bracts densely pubescent to tomentose, hairs spreading, clear-colored when fresh, brownish when dry; bracts 5–6 mm long, lanceolate.

Flowers: unisexual, greenish; sepals 3–5, valvate or slightly imbricate proximally, 0.6–1.5 cm, triangular-ovate, tips incurved and often touching at anthesis and then calyx opening by lateral slits, later tips spreading slightly but still slightly incurved, green, densely tomentose abaxially, hairs clear-colored when fresh, yellowish when dry; petals lacking (**Fig. 17**). Staminate flowers arranged in spreading to erect, terminal, pubescent panicles 4–8(–15) cm long, 12–23-flowered (**Figs. 14–15, 18**); pedicel 5–10 mm long; 1.5 × 2 cm, depressed-globose; stamens 120–160, 3–6 mm long, glabrous, filaments 5 mm long, anthers 1 mm long, oblong (**Figs. 18–19**); pistillode 1–1.5 mm tall and nearly as wide, truncate apically, fluted longitudinally (**Fig. 20**). Pistillate flowers in few-flowered, pubescent, terminal racemes 10–15 cm long or solitary at branch tips (**Figs. 16, 21**); 2.5 × 2.5 cm, globose; ovary 18 x 20 mm, depressed globose, green, densely tomentose; styles (4–)6–8, very short; stigmas(4–)6–8, 1 cm long, palmately branched, branches irregularly lobed, flattened, tortuous, spreading, reflexed against ovary, pubescent abaxially, glabrous adaxially; staminodes numerous, densely clustered around the base of the ovary, 5–10 mm long, stamen-like, yellowish (**Figs. 22–23**). Early to late Summer.

18. Staminate flowers of *Itoa orientalis*, in many-flowered panicles, are greenish and hairy. Note the calyx initially opening by slits between the sepals. (*1978-0401-S*2*).

19. Staminate flowers of *Itoa orientalis* lack petals but have thick, fleshy, greenish sepals and numerous stamens. (*1978-0401-S*2*).

20. Staminate flowers of *Itoa orientalis* have numerous stamens surrounding a short, stubby, truncate pistillode. (*1978-0401-S*2*).

21. Pistillate flowers of *Itoa orientalis* are solitary or in few-flowered racemes. (*1978-0401-S*3*).

22. Pistillate flowers of *Itoa orientalis* have palmately and irregularly branched, flattened, tortuous, spreading stigmas reflexed against the ovary. Note the numerous, yellow staminodes at the base on the left. (*1978-0401-S*1*).

23. Pistillate flower of *Itoa orientalis* has greenish sepals, curious stigmas, a tomentose ovary, and numerous staminodes at the base. (*1978-0401-S*3*).

Fruit: capsule, 9 × 6 cm, ovoid, greenish becoming densely orange-yellow or reddish tomentose when ripe (**Figs. 24–25**), becoming glabrous, (5–)6–8 valvate, first splitting from the apex down (**Fig. 26**) then from the base up to separate from the placental ridges, pericarp persistent, woody, conspicuously zigzag (**Figs. 27–28**), typically detaching from the woody placental strips; seed compressed, vertically arranged, with irregularly triangular, flattened, dark to light brown, membranous, wing to 2 cm long, actual seed small, 3 mm long, ovoid, black (**Fig. 29**). Late Summer to Fall.

Distribution and Ecology: China (Guangxi, Guizhou, Hainan, Sichuan, Yunnan). Vietnam. Bhutan. Laos. Moist, evergreen, broad-leaved forests from 500–1,700 m elevation.

Conservation Status: The IUCN Red List of Threatened Species (IUCN 2019) gave *Itoa orientalis* a conservation ranking of Least Concern.

Discussion: The genus and species descriptions are from Sleumer (1954), Yang and Zmartzy (2007), and our examination of cultivated plants at the Los Angeles County Arboretum and Botanic Garden, Arcadia, California.

Hemsley cited two of Henry's specimens (*9408* and *10703*) upon which he based *Itoa orientalis*; thus, they are syntypes. In preparing the Flacourtiaceae treatment for *Flora Malesiana* (Sleumer 1954), Hermann Otto Sleumer (1906–1993), born in Germany but doing much of his work from Holland and a world authority on Ericaceae and Flacourtiaceae, examined the then syntypes of *I. orientalis* at K and annotated *Henry 9408* as the lectotype in November, 1953. This specimen consists of two sheets, one with a leaf, fruits, and seeds and the other with just a leaf. We searched Sleumer's pertinent literature relating to Flacourtiaceae and *Itoa* (Stafleu and Cowan 1985) but were unable to find formal publication of his lectotypification; the nettlesome negative hypothesis is difficult to prove but, nonetheless, here we select the sheet of *Henry 9408* at K with leaf, fruit, and seeds as the lectotype (K-000591301) (**Fig. 30**). Isolectotypes are at K (K-000591302 [leaf only]) and MO (MO-5714088 [leaf and fruits], MO-5714089 [leaf only]). *Henry 10703* is a collection consisting of two sheets at K (K-001089366 [leaf and staminate [?] flower buds], K-001089366 [leaf, staminate inflorescence, and flowers) but now are simply paratypes.

Uncertainty abounds around the purported dioecious nature of *Itoa* and *I. orientalis* in particular. Sleumer (1954) listed it as dioecious while Hemsley (1901) and Yang and Zmartzy (2007) also listed it as dioecious but at the same time expressed doubt about this finding. At the Los Angeles County Arboretum and Botanic Garden, specimens *1978-0401-S*1* and *1978-0401-S*3* have pistillate flowers, fruits, and a few volunteer seedlings under them while specimen *1978-0401-S*2* has mostly staminate flowers although a few pistillate flowers and fruits are also visible on the tree. Thus, *I. orientalis* is mostly dioecious but not strictly so.

24. Fruits of *Itoa orientalis* are a capsule, large, greenish becoming densely orange-yellow or reddish tomentose when ripe. (*1978-0401-S*3*).

25. Fruits of *Itoa orientalis* initially split from the apex downward and after opening typically leave the zigzag pericarp remnants. (*1978-0401-S*3*).

26. Fruits of *Itoa orientalis* initially split from the apex downwards to liberate the vertically stacked, winged seeds. (*1978-0401-S*3*).

27. The persistent, woody, zigzag, pericarp remnants of *Itoa orientalis* are detaching from the placental ridges. (*1978-0401-S*3*).

28. A top view of the persistent, woody, zigzag, pericarp remnants of *Itoa orientalis* shows their detachment from the placental ridges. (*1978-0401-S*3*).

29. Seeds of *Itoa orientalis* are surrounded by a flattened, light brown, membranous wind. (*1978-0401-S*3*).

30. The lectotype of *Itoa orientalis* (*Henry 9408*) is at K (K-000591301). Photo courtesy of Royal Botanic Gardens, Kew.

Leaves of *Itoa orientalis* can be unusually large, up to 50 cm long. The largest, exceedingly striking leaves typically occur on the shady side of the tree and/or below or somewhat inside its canopy where they are protected from the sun.

Previously known only from China and Vietnam, where it occurs in rich, diverse, moist, evergreen, broad-leaved forest, *Itoa orientalis* was recently found in similar habitat in Bhutan (Long 2014) and is reported from Laos (Bayton and Grimshaw 2020). It would be unsurprising to find it in northern Thailand, Myanmar, and the Himalayan foothills of northeast India.

Two varieties of *Itoa orientalis* are recognized and can be distinguished as follows (Yang and Zmartzy 2007):

Branchlets, petioles, and leaf blades abaxially puberulous . . . . . var. *orientalis*

Branchlets, petioles, and leaf blades abaxially glabrous . . . . . var. *glabrescens*

Itoa orientalis var. orientalis

栀子皮(**原**变种) *zhi zi pi* (*yuan bian zhong*). This variety is found in China and Vietnam.

Itoa orientalis var. glabrescens C. Y. Wu ex G. S. Fan, J. Wuhan Bot. Res. 8(2): 133. 1990.

光叶栀子皮 *guang ye zhi zi pi*. This variety is restricted to China (Yan and Zmartzy 2007).

The variety of *Itoa orientalis* found in Bhutan and Laos is presently unknown.

An internet search revealed several articles showing that *Itoa orientalis* contains numerous chemical compounds that might have medicinal value or be effective pesticides.

Horticulture

The Los Angeles County Arboretum and Botanic Garden in Arcadia has four plants of *Itoa orientalis* var. *orientalis*, accessioned *1978-0401-S*1* (**Fig. 1**), *1978-0401-S*2* (**Fig. 31**), *1978-0401-S*3* (**Fig. 32**), *1978-0401-S*4* (**Fig. 33**), and were grown from seeds received in 1978 from the South China Botanical Garden, Chinese Academy of Sciences, Longyandong, Shahe, Guangzhou, China. The first three specimens are planted near each other in the Asian section while the fourth one is by itself a short distance away in a section devoted to *Magnolia* spp. About 40 years of age, they are handsome, multi-trunked trees of upright habit and have heights ranging from about 12 to nearly 17 m, canopies spreading from 8 to 14 m, and the largest trunks ranging from about 22 to 40 cm diameter (**Table 1**).

31. This *Itoa orientalis* at the Arboretum is mostly a staminate plant. (*1978-0401-S*3*).

32. This *Itoa orientalis* at the Arboretum is a pistillate plant. (*1978-0401-S*3*).

33. The gender of this *Itoa orientalis* at the Arboretum is unknown. (*1978-0401-S*4*).

Table 1. Height (m), canopy spread (m), and trunk diameters (cm, at 1.4 m above ground and at base 15 cm above ground) of four *Itoa orientalis* var. *orientalis* grown from seeds received in 1978 at the Los Angeles County Arboretum and Botanic Garden, Arcadia, California, August, 2020.

Tree accession No.	Height	Canopy (L × W)	Trunk 1 Diam.	Trunk 2 Diam.	Trunk 3 Diam.	Base Diam.[z]
*1978-0401-S*1*	16.8	10.4 × 8.2	39.6	20.0	19.4	63.1
*1978-0401-S*2*	13.8	14.3 × 10.4	28.3	29.9	24.2	___
*1978-0401-S*3*	13.7	11.3 × 8.5	21.8	19.4	8.9	___
*1978-0401-S*4*	12.2	13.1 × 9.1	40.0	21.8	___	58.2

[z]applicable if trunks originated more than 15 cm above ground.

The plants at the Arboretum, which is at 34˚N latitude, have withstood a wide range of temperatures. Summer maximum temperatures in the low to mid 30s C and winter minimums near or several degrees below 0 C are a yearly occurrence. They have tolerated episodes of strong, dry, cool, winter winds although the trees are among other trees that provide some protection. Average annual rainfall is about 400 mm, nearly all occurring from November through March, which means that the trees must be irrigated during rainless times of the year.

Itoa orientalis is a fast and robust grower, especially in the seedling and sapling stages. In September, 2019, at Hodel's request and, seeing how smitten he was with this handsome and curious tree, Henrich let Hodel dig two seedlings about 45 cm tall from under specimen *1978-0401-S*1* (**Fig. 34**). Hodel dug them carefully, ensuring to maintain an adequate root ball, and potted them into 11-ℓ (3-gallon) containers. Two months later he planted one out in a city park in Lakewood, California as part of his Southeast Trees project (Hodel 2020a, b) and as of May, 2020 it was two m tall, having grown right through a mild winter (**Fig. 35**). The second specimen also grew rapidly, and he shifted it up to a 19-ℓ (5-gallon) container in November 2019, a 26-ℓ (7-gallon) container in April 2020, and finally into a 57-ℓ (15-gallon) container in August 2020, when it was 2.5 m tall; Hodel hopes to plant it out in September or October, 2020 at another park as part of his Southeast Trees project.

Not only a fast grower as seedlings and saplings, *Itoa orientalis* shows a strong tendency for erect, straight growth and development of a strong, central leader without any staking, pruning, or training. Hodel grew the two plants in full sun in Lakewood, California and at about 1.5 m tall the two saplings put forth lateral shoots, which he headed back because he wanted the first scaffold branches to be higher above the ground. Both plants put forth another flush of lateral shoots at about two m tall and he headed these back, also. Finally, in August, 2020, at

34–35. Hodel dug this 40-cm tall seedling of *Itoa orientalis* under the mother tree (*1978-0401-S*3*) at the Arboretum in September, 2019. He grew it on and planted it out in November, 2019 at a park in Lakewood, California as part of his Southeast Trees project. By May, 2020 it was two m tall.

about 2.5 m, he chose not to head back the third flush of lateral shoots although he will select three or four of these to be the scaffold branches.

Accompanying the rapid growth as containerized saplings was a relatively high-water demand. Roots quickly filled the container and the one plant Hodel still had in a container needed nearly daily irrigation during hot spells to keep it adequately hydrated and prevent its huge leaves from wilting in the hot afternoon sun. Based on its native habitat and experiences container growing it, *Itoa orientalis* performs best with abundant water; it likely does not tolerate drought well or is a low-water use tree. So far, no pests have occurred on Hodel's young trees but specimen *1978-0401-S*1* at the Arboretum has a few leaves heavily infested, mostly on the on the abaxial surface, with giant whitefly, a seemingly annual occurrence that is likely exacerbated by inadequate water (**Figs. 36–37**).

Itoa orientalis is rare in the United States. The Arboretum might have the only plants in a public garden in California or in the United States. In addition to California, a quick internet search showed that it is sparingly cultivated in Washington state, and in Great Britain, Ireland, France,

36. Giant whitefly has infested several leaves of one specimen of *Itoa orientalis* at the Arboretum. (*1978-0401-S*1*).

37. Giant whitefly has heavily infested this leaf of one specimen of *Itoa orientalis* at the Arboretum. (*1978-0401-S*1*).

Spain, New Zealand, and Australia. Bayton and Grimshaw (2020) provide an informative account of *I. orientalis* at Tregrehan Garden, Cornwall in far southwestern England at about 50˚N latitude. There it grew to eight m tall in 10 years and had a very broad habit with wide-spreading branches (somewhat in contrast to the plants at the Arboretum) and large leaves with blades to 40 cm long. They noted that the tree is vulnerable to strong winds and that a hard frost can cause defoliation although it remains green through the winter if given shelter. They felt that a sheltered site with rich, moist soil would give the best results. *Itoa orientalis* grows successfully even farther north, at Robinson Garden at Earlscliffe, north of Dublin, Ireland at just over 53˚N latitude (Earlscliffe 2020).

Acknowledgements

We sincerely thank Liz Mendoza, Emily Vicioso, Irene Truong, and Lauren Scott of the Arboretum and Hodel's wife Marianne Hodel for help in measuring the Arboretum's trees.

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Publication Date: 15 September 2020.

PalmArbor: *http://ucanr.edu/sites/HodelPalmsTrees/PalmArbor/*

ISSN 2690-3245

Editor-In-Chief: Donald R. Hodel
Hodel Palms and Trees: *http://ucanr.edu/sites/HodelPalmsTrees/*