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## New naturalized record of the hybrid *Citrus* × *limonia* on O‘ahu (Rutaceae)

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*Citrus* × *limonia* was incidentally discovered in 2025 as a naturalized species on O‘ahu while the authors were hiking in the Kauhiuhi subdistrict of the Wai‘anae Mountain range, where it has naturally dispersed into the mid-elevation invaded forest. The species is normally cultivated but has naturalized in other parts of the world, including Asia and South America. The likely dispersal method is via endozoochory. The material was identified by Brandon Najarian, Cristóvão, and Scott K. Johnsgard.

### Rutaceae

*Citrus* × *limonia* Osbeck  
(Fig. 1–4)

### New state record

In February 2025, an unusual citrus tree was observed in the Kauhiuhi subdistrict of the Wai‘anae Mountain range on O‘ahu. This area is managed by the U.S. Navy and is not accessible to the public. The 2 m tall tree is located at approximately 335 m elevation on a dry valley floor with nearly 80% canopy cover, and the individual is adjacent to the base of a large toppled *Schinus terebinthifolia*. The tree was observed to be flowering and fruiting at the time of the first observation. During subsequent trips in June and October 2025, approximately six seedlings and four mature trees were observed immediately below the individual (Fig. 1). While conducting archival research on the vegetative history of the site, orange trees were noted in a 2024 report titled *Archaeological Inventory Survey, Subsurface Testing, and Cultural Impact Assessment at Lualualei Naval Magazine, Wai‘anae, O‘ahu, Hawai‘i*; however, the species was not identified (Department of the Navy, Naval Facilities Engineering Systems Command 2024). The seedlings were identified as *Citrus* × *limonia* using the key in Budiarto *et al.* (2021), and the mature tree was identified using the online dichotomous key for *Citrus* species provided by The Identification Technology Program (n.d.).

*Citrus* × *limonia*, also known as canton-lemon in South China, hime-lemon in Japan, limão-cravo in Brazil, and mandarin-lime in the United States, is a hybrid between the mandarin orange and the citron. After two years of growth, the tree begins to bear fruit that resembles a mandarin orange (Charles Darwin Foundation n.d.). The tree grows rapidly and has a spreading form, reaching heights of 4.5–6.0 meters. It features short thorns, flower buds and petals tinged with purple, and leaves that lack the winged petioles typical of many other citrus species (Fig. 2; Budiarto *et al.* 2021).



**Figure 1.** *Citrus × limonia*. A single mature individual was observed bearing flowers, mature orange fruits, and seedlings. Photo-documented on 19 Feb 2025.



**Figure 2.** *Citrus* × *limonia* flowers with pink petals.

The fruit is typically round, oblate, or obovate, with an irregular surface. In its immature stage, it appears green to dark green in color. As it ripens, the peel transitions to a deep yellow, becoming medium-thick to thin, leathery in texture, and dotted with prominent oil glands; it also becomes easily detachable from the flesh (Fig. 3). During this process, the base of the fruit develops furrows and a slight neck, while the apex remains rounded or faintly nipped. Fully mature fruits measure approximately 4.50–6.25 cm in width and 4.1–5.7 cm in height. The pulp inside is deep orange, emits a lime-like aroma, and is divided into 8–10 segments with tender walls that separate readily. The fruit is characterized by an exceedingly sour taste, although it has a flavor suggestive of orange and may contain between 6 and 18 small, green seeds (North Carolina State University 2022). This hybrid produces fruit abundantly from November through winter, with the fruits remaining in good condition on the tree. *Citrus × limonia* is more cold-tolerant than lime and has demonstrated greater freeze resistance than lemon, particularly in California. It thrives in mildly acidic to mildly alkaline, well-drained soils, including both loamy and clay types, and is also capable of growing in highly alkaline soils (Huxley 1992).



**Figure 3.** *Citrus × limonia* immature fruit exhibits a green coloration (left), which transitions to a deep yellow as it matures (right).

Sir Joseph Hooker originally described the species as a small, slender tree growing at the base of valleys in the Himalayan foothills, ranging from Gurhwal to the Khasia Hills. In the United States, *Citrus × limonia* was introduced to Florida in the late nineteenth century by Reasoner Brothers of Oneco, Florida. They obtained seeds from northwestern India and initially cataloged the tree as a lime (Morton 1987). Although it is often referred to as a lemon hybrid, genomic studies have confirmed that it is a first-generation (F1) hybrid resulting from a cross between a female citron (*Citrus medica*) and a male mandarin orange (*C. reticulata*) (Curk 2016).



**Figure 4.** A *Citrus x limonia* immature individual displaying a petiole with reduced wings.

Historically known as Rangpur, the fruit has been used as a substitute for lime due to its intense acidity. However, the label “lime” is somewhat misleading, as the Rangpur bears little botanical resemblance to true limes. In Brazil and Argentina, it was commonly used as a rootstock until the late 1930s, but trees grafted onto it were found to be short-lived and eventually fell out of favor (Morton 1987).

Today, this intensely sour and bitter hybrid is found growing as a casual dooryard tree in Florida and as a minor commercial fruit tree in California. It has also naturalized in tropical regions, particularly in South America, India, and China after escaping cultivation (Khoe 2016, Wu *et al.* 2018). In Hawai‘i it was likely introduced as an ornamental tree, though it is notably absent from major botanical references, such as Staples & Herbst (2005) and Imada *et al.* (2025), and no cultivated specimens are currently held at the Bishop Museum (BISH).

*Citrus ×limonia* is visually similar to several other citrus species but can be identified by its wingless petioles and the purple-pink coloration on the outer surfaces of its petals. Seedlings are notable for their prominent spines, green young leaves, and long petioles with reduced wings (Fig. 4; Budiarto *et al.* 2021).

*Material examined.* O‘AHU: Kauhiuhi, trail through valley to upper peak, lower elevation invaded forest, shaded, single mature individual found fruiting and flowering, approximately six immature seedlings immediately beneath its canopy, 335 m, 21.45031, -158.10575, 21 May 2026, BISH 805428, *B. Najarian s.n.*

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