Strawberry guava has characteristic gray-brown to reddish bark that peels off in irregular patterns.

Common Guava

Common guava (*Psidium guajava* L.) is a shrub or small tree, usually under 15 feet tall (rarely to 30 feet), with scaly bark. Branches are 4-angled and hairy. The opposite leaves have a short stalk/petiole and elliptic to oblong leathery blades. The lower blade surface is covered with soft hairs, contains numerous glandular dots and has very noticeable riblike lateral veins. Inflorescences are usually 1-flowered in leaf axils. The five sepals are united. The five petals are white, showy, rounded and just under 1 inch long. Stamens are numerous. The ovary is imbedded below the rest of the flower parts (inferior). The usually dull yellow fruits are rounded or pear-shaped, manyseeded berries about 1 to 2 1/2 inches long with pink or yellowish flesh. Reproduction is by seeds. Blooming occurs all year.

Common guava has been cultivated and distributed by man and animals for so long that it is difficult to be certain of its place of origin but it is believed to be from an area extending from southern Mexico into or through Central America (Morton 1987). It is now cultivated and escaped throughout the New and Old World tropics. In addition to its value for edible fruit, the wood is valued in some parts of the world, tannin is extracted for use in tanning and for dyes and, in addi

Psidium cattleianum, Deliciously dangerous in Hawaii

By Charles Wikler

Eating the delicious red or yellow fruits of strawberry guava (*Psidium cattleianum*) we would never imagine how big the problem caused by these plants is in many tropical regions. This species is invading extensive areas, dispersing into important natural habitats, ecologically disrupting them. In addition, this plant is host to several species of fruit flies.

Introduced to Hawaii about 1825, strawberry guava quickly escaped from cultivation. It has become the most important forest weed in Hawaii (Smith, 1985) due to suitable soil and climatic factors, the absence of natural enemies, and effective dispersal by several different agents. Initially, birds disseminated seeds. Feral pigs, relatively recent invaders of the Hawaiian ecosystem, have since become the most important dispersal agent of strawberry guava seeds (Diong, 1982).

Strawberry guava possesses several of the characteristics of an opportunist invasive species, but it seems that its ability to grow clonally is the main reason for its successful invasion and domination of intact native forests in the Hawaiian archipelago (Huenneke, 1991). This plant is an excellent example of a plant once confined to a small region but now a widespread problem throughout the tropics and subtropics.

From the beginning, studies about this plant generated considerable debate over which scientific name was published correctly for *Psidium cattleianum*. Sabine (1821) named the plant in honor of William Cattley, the first person to successfully cultivate the species in Britain. Some authors considered Raddi as the first to describe the plant, also in 1821, but in the literature search, Raddi's description refers to the plant as Psidium littorale in 1823. Thus, the name Psidium littorale is usually considered a junior synonym, as the original descriptions of both represent the same species.

According to Fosberg (1941) in Ellshoff et al. (1995), the common name used for strawberry guava is "araca" in Brazil, "waiwai" in Hawaii, and "Cattley guava" among some American horticulturists. Strawberry guava is also mentioned in the literature as "goiave de L'Afrique", in the Dominican Republic, "araca-saiyu" and "guayabo amarillo" in Argentina, "araza" in Uruguay, "Calcutta-guava" in India, "china-guava" for the British,

"goyavier of St. Martin" in Guadeloupe, "goyavier fraise" for the French, "goyavier prune" in Martinique and "purple-guava" in Jamaica.

Hoehne (1946) mentioned that the diKerentiahon between the species becomes complicated for what is called "araca." Although the exact origin of the type specimen is not known, it seems that the plant was cultivated in Asia and America. However, the type locality of *P. Iittorale* is cited by Raddi (1823) as the coasts of Brazil.

Two botanical forms of strawberry guava tree are recognized based on fruit color. They are the red fruit *P. cattleianum f. cattleianum* (*P. Iittorale var. Iongipes*) and the yellow fruit *P. cattleianum f. Iucidum* (*P. Iittorale var. Iucidum*).

Geographical distribution in the area of origin

In Brazil, the genus Psidium is represented by 9 species, including P. cattleianum. The plant occurs from the South of Espirito Santo State in Brazil to Uruguay, (from 20° and 32° S). Strawberry guava is a characteristic bush of the "restinga," typical vegetation of the Atlantic Rain Forest, where it is widely dispersed. Although present, it is not too frequent in the first plateau. The species occurs in humid soils, in small woods (capoeiras), and the border of creeks and semi-devastated forests. It is also quite frequent in the coastal swampy fields along the littoral zone of the southern states of Santa Catarina and Rio Grande do Sul. It can be found in and around the southern plateau, occurring in the ciliary forests, as well as in disturbed fields (Reitz, Klein & Reis, 1983).

Morpholog of the varieties of *Psidium cattleianum*

According to Wikler (1999), the main differences between the yellow and red forms of strawberry guava are:

- *P. cattleianum var. Iucidum* (yellow form)

It is commonly a shrub in the coast, as part of a vegetation formation called "restinga", where a wide variety of plants grow on the sandy substrate with a high water table. The climate in the coast is hot and humid with temperatures between 18 and 22 ℃ and annual rainfall between 1430-2450 mm. Its height varies between 2.5 and 4 meters, rarely exceeding 5 m high. The trunk is tortuous and with very characteristic grayish-brown coloration, being unmistakable in the places where it is found. Its crown is round and quite dense. The fruits are yellow, as well as the endocarp that ranges from light yellow to white. In Parana State it is distributed along the coast, and on the first and second plateaus.

Psidium cattleianum var. Iucidum

- *P. cattleianum var. cattleianum* (red form)

The red form is a tree, with heights from 2.5 meters up to 20 meters. Its trunk has the same color of the yellow form although it differs in shape being straight and cylindrical with a larger diameter. Its crown is slightly elongated and quite dense. Its fruit and its endocarp are red colored. In the Araucaria Forest it is found inside the woods but exclusively in the first plateau, ranging from 6501100 m. The climate is hot and humid, with temperature between 15 - 19 ℃ and 1250 - 2500 mm annual rainfall.

Psidium cattleianum var. cattleianum

Biocontrol in Hawaii

Unable to control strawberry guava by mechanical and chemical means in Hawaii, the U.S. National Park Service initiated efforts to find biological control agents against this weed. A cooperative program between the Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, and the Parana Forest Research Foundation and the Federal University of Parana was established in March 1991.

tion to other medicinal uses, the roots, bark, leaves and immature fruits are used to halt gastroenteritis, diarrhea and dysentery throughout the tropics (Morton 1987). In Mexico, the tree may be parasitized by mistletoe that causes rosette-like formations called wood flowers, which are sold as ornamental curiosities (Morton 1987).

According to P. W. Reasoner, common guava was introduced to Florida from Cuba in 1847 (Popenoe 1920). However, it was already reported as naturalized in 1765 (DeBrahm 1773). The 1887-1888 Catalog and Price List for Royal Palm Nurseries states: "The guava has become a necessity to South Florida; is to South Florida what the peach is to Georgia". It has been grown successfully as far north as the Pinellas peninsula [sic] on the west coast and Cape Canaveral on the east coast (Popenoe 1920) and was grown commercially at Palma Sola, Punta Gorda, Opalacha, Indiantown, and other localities (Barrett 1956). Three cultivars are now grown commercially, Homestead and two private selections. About 225 acres are in production in Dade (90%), Lee, Broward, and Palm Beach Counties (Jonathan Crane, personal communication). This acreage has been expanding since 1992 and has greater potential due to expanding Asian and Latin markets. The crop is worth in excess of $3,000,000 annually. In Hawaii, 7,000 acres are grown. While available in the horticultural trade, common guava is relatively insignificant in the current ornamental grower and landscape market and a phase-out of production and sale by Florida ornamental growers is encouraged by an agreement between the FLEPPC and the Florida Nurserymen and Growers Association (Aylsworth 1999).

Common guava grows and fruits under unfavorable conditions, spreads rapidly by seeds and has become a weed in many areas (Popenoe 1920). In fact, it is present as a weed in 27 countries and considered a common to serious pest in nine of these (Holm _ aL 1979). It forms thickets and has a serious impact on native forests and open woodlands (Cronk and Fuller 1995). Small, in 1933, reported it in hammocks, roadsides, pinelands, and old fields of peninsular Florida and the Keys, and it was further reported spreading into hammocks and pinelands in 1971 (Long and Lakela). It now ranges from Pinellas and Brevard Counties south to the Keys (Nelson 1994) and has been reported from Florida parks and preserves in Broward, Collier, Dade, Highlands, Lee, Martin, Osceola, Palm Beach, and Sarasota Counties (FLEPPC 2000). In Jonathon Dickinson and Seabranch State Parks alone 1,163 stems were treated in 1998-99 (Florida Park Service). Trees are controlled by basal bark applications of Garlon 4, cut stump applications of Garlon 4 or 3A, and hand pulling of seedlings.

Strawberry Guava

Strawberry guava [P. cattleianum Sabine] is a shrub or small tree to 25 feet tall with smooth, gray-brown to reddish bark that is inclined to peel off in irregular patterns. The slick, leathery, evergreen, opposite leaves are elliptic to somewhat broader towards the tip and up to 3 inches long with a short stalk/petiole. The lateral nerves in the blades are ascending and curve forward without forming a distinct marginal nerve. The inflorescence is stalked and 1-flowered from the leaf axils. Flowers have five united sepals. The five petals are white, showy, rounded and about 1 inch wide. Stamens are numerous and anthers are attached in the center and split longitudinally. The ovary is imbedded below the rest of the flower parts (inferior). The red-purple or yellow fruits are almost

A survey identified potential biological control agents from which the impacts of seven insect species and their effects on *Psidium cattleianum* are discussed by Wickler et al. (1999): a lead gall produced by *Tectococcus ovatus* (Homoptera, Eriococcidae), bud galls formed in response to *Dasineura gigantea* (Diptera, Cecidomyiidae), a shoot gall produced by *Eurytoma* sp. (Hymenoptera, Eurytomidae), a seed gall induced by *Sycophilia* sp. (Hymenoptera, Eurytomidae), another leaf gall formed in response to an unknown species of Psyllidae, the sawfly, *Haplostegus epimelas* (Hymenoptera, Pergidae), and the chrysomelid *Lamprosoma azureum* (Coleoptera, Chrysomelidae).

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round, many-seeded berries about 1 and 1/ 2 inches long with white flesh. Reproduction is by seeds. Blooming usually occurs in early summer. Native to southeastern Brazil, it is planted in the subtropics and tropics. Strawberry guava can survive temperatures as low as 22 F (Morton 1987) and is grown as far north as Alachua County.

P. cattleianum occurs as two distinct botanical varieties. The common redfruited variety is called Cattley guava or strawberry guava, *P. cattleianum* Sabine var. *cattleianum* [*P. littorale* Raddi var. *longipes* (O. Berg) Fosberg] (Fosberg 1941). This variety is a small dense tree. It makes a nice ornamental with the copious array of dark shiny green leaves and bright red fruits. The fruit is sweet and obviously eaten and spread by wildlife and cattle. As an escape, strawberry guava has been found on floodplains and in oak hammocks and cattle pens from Osceola County south into Lee County (Wunderlin *et al*. 1995). The common name, strawberry guava, comes from the flavor of the fruit, which tastes like a strawberry. The fruits are eaten fresh or used for making jelly, drinks and other culinary uses, however, it is not grown commercially for its fruit in Florida. It is an attractive dooryard tree, presenting "_____ an almost exotic or Japanese picture as an accent" and used as a hedge (Stressau 1986).

The less frequent yellow-fruited variety is called yellow Cattley guava or yellow strawberry guava, *P. cattleianum* Sabine var. *lucidum* Hort. [*P. littorale* Raddi var. lucidum (Degener) Fosberg] (Fosberg 1941). This variety is a loosely branched small tree said to be useful for reforestation (Staff, Hortus Third 1976). The fruit is sulphur-yellow, translucent and somewhat acid when ripe. Yellow Strawberry guava forms dense thickets along the margin of the Little Manatee River in Hillsborough County. This variety has also been listed [sic] as *P. lucidum* Hort., *P. chinense* Lodd. ex Lodd. and *P. sinense* (not a valid name, probably a misspelling of *chinense*) (Popenoe 1920).

Strawberry guava forms thickets and shades out native vegetation in forests and open woodlands (Cronk and Fuller 1995). It has had catastrophic effects on native habitats of Mauritius, and it is considered among the worst pest plants in Hawaii (see Wikler, this issue), where it has invaded a variety of natural areas (Cronk and Fuller 1995). It has become dominant in native forests of Hawaii, including in two national parks, where its clonal spread is enhanced by activities of feral pigs (Huenneke and Vitousek 1990).

Strawberry guava first appeared in the horticulture trade in Florida in the 1887-1888 Catalog and Price List for Royal Palm Nurseries. However, it was not included in southeastern flora by Small (1933). It was noted as "often growing wild" in 1956 by Barrett (1956). It has been reported in Florida parks and preserves in Pinellas, Hillsborough, Martin, and Palm Beach Counties (FLEPPC 1996). In Jonathan Dickinson State Park and Seabranch Preserve alone, 2,087 Strawberry guava stems were controlled in 1998-99 (Florida Park Service). Where possible, stems are cut and treated with Garlon 3A. In Jonathan Dickinson State Park, it was necessary for DEP to bulldoze and restore a three acre site (Richard Roberts, personal communication). At Seabranch, up to seven guava plants per square meter occur and 5-15% of vegetation has consisted of Strawberry quava in various sites in 35 acres John Griner, personal communication). Twenty acres have been restored by selective removal of this pest plant and planting of native vegetation.

In summary, the guavas have provided us with delicious desserts, ornamental plantings, and commercial income. On the other hand, common and Strawberry guavas have escaped cultivation and are weeds in natural areas requiring expenditure of public funds to protect native plant communites. This is an example of the dilemma we face with many introduced plants that are both commercially valuable and natural area weeds.

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