

SOLANACEAE the potato family

by L. Bohs



Shrubs, herbs, woody vines, occasionally trees, glabrous or pubescent with simple, glandular, branched, or star-shaped hairs, sometimes with prickles. Lvs alternate or paired but not truly opposite, simple or lobed to pinnately compound; stipules absent. Infl composed of variously modified terminal cymes, often appearing axillary or outside axil, or flws solitary; bracts present or absent. Flws usu radially symmetrical (sometimes bilaterally symmetrical), usu bisexual; cal base and cor base tubular, apex usu 5-lobed; stam usu 5, fil attached on cor tube, alternating with cor lobes, anth opening by apical pores or lengthwise slits; ovary superior, 2- or 4-celled (rarely more), style 1, stigma truncate or pinhead-like, often 2-lobed. Frt a berry or 2-4-valved, dehiscent capsule.

The Solanaceae include about 90 genera and 2,800 species, worldwide in distribution but best represented in the New World tropics. The family is probably most closely related to the

Convolvulaceae. Both families have internal phloem (a band of conducting tissue both to the inside and to the outside of the xylem bundles in the stem) and generally radially symmetrical, 5-parted flowers. Some solanaceous genera, however, such as *Browallia* and *Streptosolen*, have bilaterally symmetrical corollas and fewer stamens than corolla lobes, rendering them superficially similar to the Scrophulariaceae. The Solanaceae can be distinguished from the Convolvulaceae by their more or less numerous ovules and seeds, as opposed to the usually 2 ovules per carpel found in the Convolvulaceae.

Members of the Solanaceae include some of our most important food crops, such as potato, tomato, eggplant, and chili peppers, as well as tobacco. Alkaloids, especially tropane, nicotine,

Key to Solanaceae

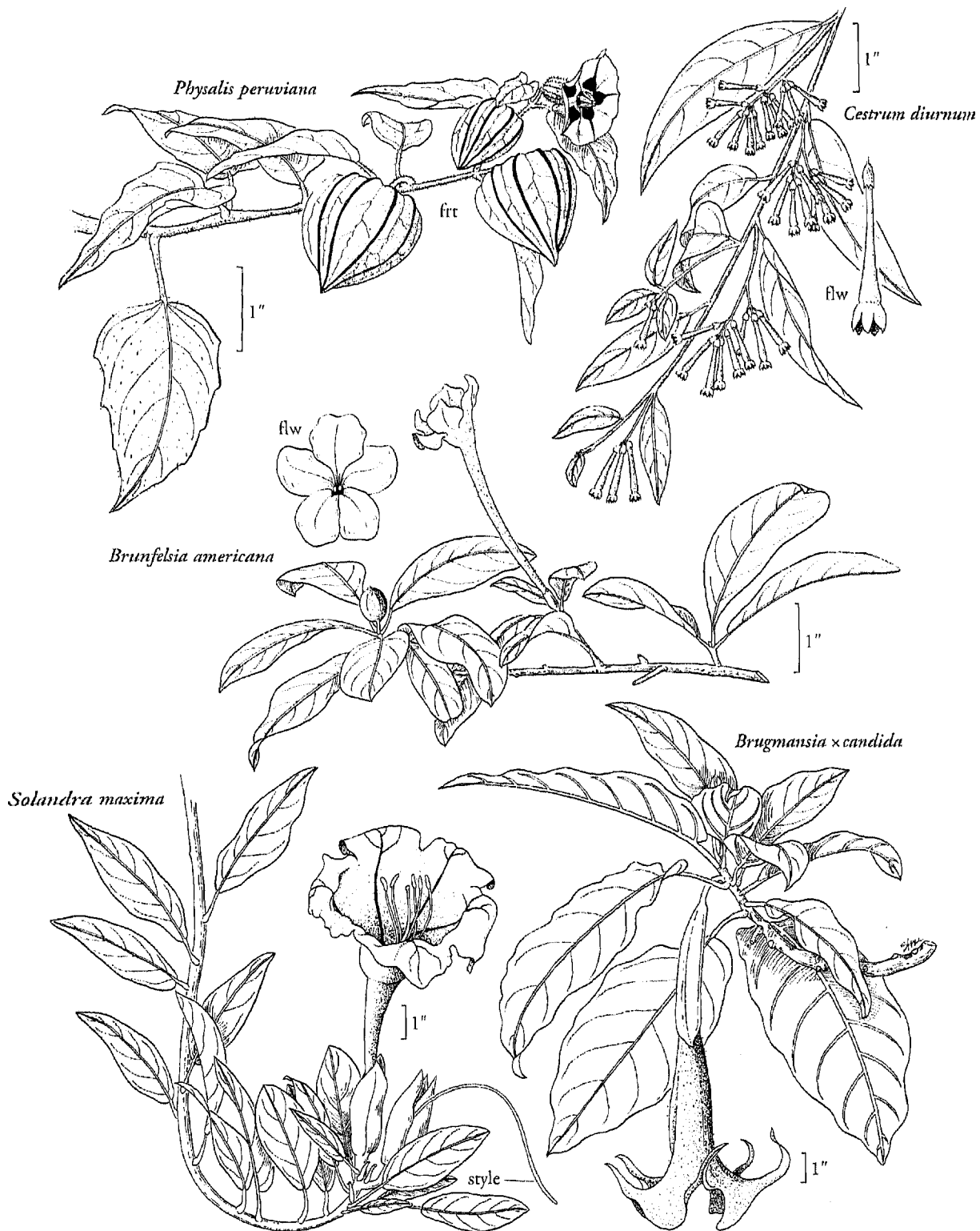
1. Cor >6" long (2).
1. Cor <6" long (3).
- 2(1). Plant climbing; lvs glabrous, leathery; cor lobes entire, undulate, or fringed, without tail-like tips *Solanandra maxima*
2. Plant erect; lvs pubescent, papery; cor lobes with tail-like tips *Brugmansia × candida*
- 3(1). Stam usu 4 (if 5, then 1 reduced to sterile staminode) (4).
3. Stam 5 (8).
- 4(3). Cor yellow-orange or orange-red; cor tube twisted *Streptosolen jamesonii*
4. Cor blue, purple, or white (aging yellowish); cor tube straight (5).
- 5(4). Plants herbaceous (6).
5. Plants woody (7).
- 6(5). Cor tube >1" long, limb >1" across; ovary and frt glabrous *Browallia speciosa*
6. Cor tube <1" long, limb <1" across; ovary and frt apex pubescent *Browallia americana*
- 7(5). Cor tube >5× as long as cal; cor white, turning yellowish with age *Brunfelsia americana*
7. Cor tube ca 2-5× as long as cal; cor purple fading to white or pale violet *Brunfelsia australis*
- 8(3). Cor tubular, salver- or funnel-shaped, with narrow tube >0.3" long (9).
8. Cor wheel-, star-, or bell-shaped, with tube <0.3" long (13).
- 9(8). Woody shrubs or trees without sticky-glandular pubescence (10).
9. Herbaceous plants, sometimes with abundant sticky-glandular pubescence (11).
- 10(9). Frt a berry *Cestrum*
10. Frt a dry capsule *Nicotiana glauca*
- 11(9). Plants erect, >2' tall; lvs large (to 20" long) *Nicotiana tabacum*
11. Plants erect or sprawling, <2' tall; lvs small (<2.5" long) (12).
- 12(11). Cor tube narrow, abruptly expanded into cup-shaped limb; cor ca <1" Ø *Nierembergia hippomanica*
12. Cor tube gradually widened toward apex; cor >1" Ø *Petunia × hybrida*
- 13(8). Cal enlarging and completely enclosing frt (14).
13. Cal, if enlarging, not completely enclosing frt (15).
- 14(13). Anth not twisted after opening; plants pubescent *Physalis peruviana*
14. Anth twisted after opening; plants nearly glabrous *Physalis philadelphica*
- 15(13). Anth opening by terminal pores (sometimes enlarging into lengthwise slits) (16).
15. Anth opening by lengthwise slits (17).
- 16(15). Cal margin 5-lobed *Solanum* (including *Lycopersicon*)
16. Cal margin truncate, with 5 or 10 narrow lobes borne below margin *Lycianthes rantonnei*
- 17(15). Spiny shrubs; cor purplish *Lycium chinense*
17. Herbs or small nonspiny shrubs; cor usu whitish (18).
- 18(17). Cor with yellow-green or ran spots at bases of lobes; anth yellow *Capsicum baccatum*
18. Cor without spots at bases of lobes; anth blue to purple *Capsicum annuum*

and steroidal types, are common and account for the use of some members of the Solanaceae as medicines, poisons, and hallucinogens. Even food plants are apt to have toxic parts, such as the leaves of tomato plants, all parts of the potato plant except the tubers, and all parts of the eggplant except the fruit.^{5,78} Many species are cultivated as ornamentals for their showy fruit or flowers, and others are noxious weeds.

Several references may be useful for those desiring more information about the Solanaceae. The native and naturalized

Solanaceae of Hawai'i are covered in the *Manual of the Flowering Plants of Hawai'i*.¹⁵³² A general introduction to the family is *Nightshades: The Paradoxical Plants*.⁵⁹⁷ Floras that identify and describe the Solanaceae of Australia, New Guinea, and Panama are useful for identifying taxa not included here.^{1424,1429,1432,1435}

There are 14 genera and 34 species of cultivated Solanaceae likely to be encountered in home gardens in Hawai'i. Additional taxa are grown in botanical gardens and arboreta.³⁰¹



BROWALLIA Linnaeus (honors J. Browal, 1707–1755, Bishop of Åbo and friend of Linnaeus)

Spineless herbs <3' tall, glabrous or glandular-pubescent. Lvs alternate or paired, simple, usu petiolate; blades mostly entire. Infl raceme-like or flws solitary and axillary. Flw cal tubular, 4- or 5-lobed, enlarging in frt; cor salver-shaped, bilaterally symmetrical, tube straight, upper end swollen, mouth contracted; stam usu 4, of two lengths, 1 sterile stam sometimes present; ovary 2-celled. Frt a 2- or 4-valved dry capsule, enclosed in cal. Seeds numerous, <0.1" long.

More than 20 species have been described in *Browallia*, but these have been reduced to just two species, with the remainder placed in other genera.⁴²⁹ *Browallia viscosa* Kunth, with densely glandular inflorescences, may also be a distinct species, and critical study of *Browallia* may uncover other species. The two species are native to Central and tropical South America and are widely cultivated as ornamentals.

In Hawai'i, browallias are grown as bedding plants or in containers, much like petunias. They make a colorful display when massed in a planter, border, or hanging basket. The flowers are sometimes used in mixed leis.⁹⁴³ They are cultivated like petunias or other winter annuals. Shoot tips should be pinched to encourage branching and plants fed with a time-release or dilute liquid fertilizer to promote vigorous growth and free blooming. Browallias can be propagated from seed, or small plants can be purchased from nurseries or garden shops.

Browallia speciosa W. J. Hooker

Lf blades ovate or elliptic, to 3" long. Flw cal tube inflated, bladder-like, with 5 prominent angles, divided ca 1/3 its length, 5 lobes pointed; cor salver-shaped, blue, purple, or white, center often with irregular-margined white eye, tube >1" long, glabrous inside, puberulent outside, limb >1" Ø, 5-lobed, lobes pointed; ovary glabrous. Capsule glabrous, shorter than cal.

Browallia speciosa is commonly grown as a greenhouse ornamental or houseplant. According to one source, this species is a tetraploid, meaning it has twice the usual number of chromosomes.⁴²⁹ It is rarely seen outside cultivation. Propagation is by seeds or cuttings.

Other Browallia

Browallia americana Linnaeus [Syn.: *B. demissa* Linnaeus] is sometimes grown as a garden ornamental and often escapes cultivation to become naturalized. It is quite variable but can be distinguished from *B. speciosa* by its smaller flowers (tube less than 1" long, limb less than 1" in diameter), rounded corolla lobes, and pubescent ovaries and capsules. It is grown outdoors as a bedding plant.⁴⁰⁰

BRUGMANSIA Persoon (honors S. J. Brugmans, 1763–1819, Dutch botanist), ANGEL'S-TRUMPET, FLORIPONDIO, TREE DATURA

Spineless trees or shrubs, pubescent, hairs simple, sometimes glandular. Lvs alternate, simple, petiolate; blade margins entire or coarsely toothed. Flws solitary, usu pendent; cal tubular, splitting irregularly into 1–5 lobes; cor funnel-shaped or almost tubular, usu large, 5-lobed; stam 5, equal, anth opening by lengthwise slits; ovary 2-celled. Frt an indehiscent capsule or berry, smooth, fleshy or woody. Seeds numerous, often angled, seed coat thick, corky.

Brugmansia includes some six to ten species native to South America. These species were originally included in the genus *Datura* but are now separated on the basis of their treelike habit, pendent flowers, and spineless, fleshy, indehiscent fruit.⁸⁶³ Several hybrids have been made in gardens,⁶⁹⁸ along with cultivars selected and named from individual species.¹³²⁰ Tree daturas are fre-

quently cultivated as ornamentals for their spectacular flowers that become fragrant in the evening. The plants are reported to bloom most profusely during the full moon.⁹²¹ In South America they are employed as medicines and hallucinogens, reflecting their high content of tropane alkaloids, but large doses of any part of the plant are toxic and potentially fatal.¹³⁰¹ Propagation is usually by cuttings, for the plants rarely set fruit. Tree daturas are self-incompatible; a single plant is not self-fertile and must be crossed with another individual with a different genetic composition in order to produce fruit and seeds.

Brugmansia ×candida Persoon [Syn.: *Datura candida* (Persoon) Safford; Misapplied: *Brugmansia arborea*, *Datura arborea*], ANGEL'S-TRUMPET; H: NĀNĀHONUA

Small tree 10–15' tall. Lf blades ovate or elliptic, to 15" long, base rounded or tapered, often unequal-sided, margin entire, undulate, or shallowly toothed, apex acute. Flw cal spathe-like, 4–6" long, long-tapering to point (rarely 2–5-toothed); cor trumpet-shaped, >10" long, white, pale orange, or pinkish (rarely yellow), tube flaring beyond cal, limb to 6" Ø, with 5 tail-like lobes 1–1.5" long; anth free, 1–1.5" long. Frt (rare in Hawai'i) usu spindle-shaped or oblong-cylindrical, to 8" long, glabrous. (see p. 529)

Brugmansia ×candida is the most commonly cultivated tree datura. It is unknown outside cultivation and thought to be a hybrid between two Andean species, *B. aurea* Lagerheim and *B. versicolor* Lagerheim. Most cultivated material labeled *B. aurea* is actually *B. ×candida*. In 1825, the HMS *Blonde* arrived in Honolulu bearing a consignment of plants, seeds, and bulbs; included was a single plant called *Datura arborea*.¹⁰³⁰ The plant was almost certainly this hybrid. Flower color varies from pure white through shades of cream and pale apricot to salmon pink. Fruit is rarely produced in the Islands, perhaps because a suitable pollinator is lacking or only one genetic type (clone) is present.

Cases of poisoning through contact with the sap or handling of the flowers are reported.^{57,1013} Getting the sap in the eyes (usually by rubbing them with the fingers) causes temporary dilation of the pupils and sometimes more serious damage. Some people find that the heavy fragrance of the flowers gives them a headache, and others report feeling stupefied by it. Despite these disadvantages, angel's-trumpet is commonly grown as an ornamental. Obviously, this is not a plant to grow where pets or small children will come in contact with it.

In Hawai'i these small trees make stunning specimen plants, mass plantings, untrimmed hedges, or windbreaks.^{231,1326} Angel's-trumpet prefers cool valleys and ridge tops with rich, well-watered, well-drained soil; it does not tolerate drought, wind, or salt exposure. Full or filtered sun is best. Cultivated plants may persist by sprouting sucker shoots from the cut trunks or roots. The shrubs should be pruned heavily to maintain their shape and encourage flowering. The foliage emits a rank odor when handled or bruised. Judicious application of a general fertilizer three or four times a year assures vigorous growth, although too much nitrogen encourages leaf production at the expense of flowers.⁹²¹ Chinese rose beetles, grasshoppers, and spider mites attack the foliage; although unsightly, their depredations cause no serious harm to a healthy plant and can be controlled with chemical sprays if necessary. Propagation is nearly always from cuttings.

BRUNFELSIA Linnaeus (honors O. Brunfels, 1489–1534, German botanist)

Spineless shrubs or treelets, glabrous or with simple or treelike hairs. Lvs alternate, simple; blades entire, often leathery, shining. Infl axillary or terminal. Flws fragrant; cal tubular or bell-shaped, 5-lobed; cor

silver-shaped, slightly bilaterally symmetrical, tube long, straight, lobes 5, broad, spreading, obtuse; stam 4 (rarely 5), unequal, included; ovary 2-celled. Frt a capsule. Seeds angled, to 0.5" long.

Brunfelsia includes about 40 species native to the New World tropics and widely cultivated for their showy flowers. Most species contain toxic alkaloids and some have been used as medicines or hallucinogens in South America.¹³⁰¹ Some species have edible fruit.

Brunfelsias are often cultivated in greenhouses and outdoors in frost-free areas. They require organically rich soil and supplementary fertilizer during the blooming season. They are not prone to attack by many diseases or pests. Propagation is by seeds or cuttings from new growth. Numerous species and a few hybrids are cultivated in Hawai'i's botanical gardens,⁷⁰¹ but only two species are likely to be found in home gardens.

Brunfelsia americana Linnaeus, DAMA-DEL-NOCHE,
LADY-OF-THE-NIGHT

Shrub ca 10' tall, nearly glabrous or puberulent. Lf peti ≤ 0.25 " long; blades elliptic to obovate, 1.5–4" long, papery to somewhat leathery, base tapered, apex acute or obtuse. Flws solitary at bran tips; pedicels to 0.5" long; cal bell-shaped, 0.25" long, lobed to $\frac{1}{4}$ its length into 5 narrow lobes; cor white, yellowish with age, tube 2–2.5" long (ca 10 \times as long as cal), limb 1–2" \emptyset . Frt globose, 0.5–0.75" \emptyset , exceeding cal, orange. (see p. 529)

Brunfelsia americana, originally from the West Indies, is commonly cultivated for its showy flowers that are fragrant at night. The fruit is used medicinally in Martinique as a treatment for diarrhea, but because related species contain toxic compounds ingestion of any part of the plant is not recommended.²³¹

Lady-of-the-night is used as a flowering specimen plant, informal hedge, or container plant. The nocturnal fragrance may be too intense for some homeowners; nonetheless, the flowers are used in lei making.⁹⁶³ Although adaptable in its cultural requirements and able to grow almost anywhere in Hawai'i, *B. americana* prefers hot, sunny, dry areas with rich, well-drained soil; it does not grow well in beach areas exposed to salt spray.²³¹ In southern Florida it has been recommended for xeriscape use as a plant moderately tolerant of dry conditions.¹³⁷¹ It should be pruned only lightly. Propagation is from seed or by cuttings.

Brunfelsia australis Bentham [Misapplied: *B. latifolia*],
YESTERDAY-TODAY-AND-TOMORROW

Shrub to ca 12' tall, glabrous. Lf peti ≤ 0.25 " long; blades elliptic to obovate, 1–5" long, slightly leathery, base tapered, apex obtuse or sometimes acute. Infl 1–3 (rarely 4)-flwd, pedicels to 0.25" long. Flw cal tubular or bell-shaped, 0.25–0.5" long, lobed ca $\frac{1}{3}$ its length into 5 broad lobes, glabrous; cor purple with white eye, fading to white, tube 0.75–1.25" long (2–5 \times as long as cal), limb 1–1.5" \emptyset . Frt globose, ca 0.5" \emptyset , exceeding cal, orange.

This species is native to southern Brazil, Paraguay, and Argentina and widely cultivated for its showy flowers that age from purple to white. They are fragrant both day and night.

In Hawai'i, *B. australis* blooms from late winter to early summer, a time of year when few other plants are flowering. It is used as a specimen plant, massed planting, or container plant. A shade-loving species, it prefers cool, moist areas with rich, well-drained, well-watered soil.²³¹ Sandy or nutrient-poor soils may lead to yellowing of the foliage (chlorosis), which can be corrected with a fertilizer that includes minor elements applied as a foliar spray or soil drench. Plants should be pruned heavily after flowering to stimulate new growth and flower production for the next season. The flowers are sometimes used in lei making.⁹⁶³ Propagation is from seed or cuttings.

CAPSICUM Linnaeus (origin obscure, but perhaps from Lat. *capsa*, box, referring to the shape of the fruit; or from Gk. *kapto*, to bite, referring to their pungency), CHILI PEPPER, PEPPER; H: NŌI, NŌI PEPA; V: OT

Herbs or shrubs, glabrous or pubescent with simple hairs. Lvs alternate or paired, simple, petiolate; blades ovate to elliptic, base truncate or tapered into peti, margins entire. Infl axillary, a few-flwd cluster or flw solitary. Flw cal truncate or 5–10-toothed, enlarging in frt; cor star- to bell-shaped, 5-lobed, white, yellowish, greenish, or purple; stam 5, equal, anth opening by lengthwise slits; ovary 2-celled. Frt a fleshy berry, hollow inside. Seeds flattened, yellow or dark brown.

The genus *Capsicum* includes about 20 wild and three to five domesticated species originally from tropical America but now cultivated worldwide. The pungent fruit is one of the world's most important spices. Nonpungent cultivars are eaten as vegetables, and some types with brightly colored fruit are grown as ornamentals. The fruit flesh of a sweet red variety is used to make the pimentos in stuffed olives, cheeses, and processed meats.

Capsicum, or chili pepper, should not be confused with black pepper, *Piper nigrum*, an Old World species in the Piperaceae. Chili peppers were not known in the Old World until after Columbus's voyages to the West Indies. After 1493, many varieties of chili peppers were introduced to Europe. The paprika pepper, for example, is commonly used as an ingredient in Hungarian cooking. *Capsicum* peppers also spread rapidly to Asia, where they now assume an important role in Indian, Southeast Asian, and western Chinese cuisines.

The pungency of peppers is caused by capsaicin in the placenta, the whitish tissue containing the seeds. A single dominant gene controls this compound's presence.¹¹³² Peppers are good sources of vitamins A and C¹³³² and are still used in medicine to some extent in both Western and Asian cultures.^{602,1133} Peppers are often responsible for emergency room visits: once handled, the capsaicin gets into the skin, causing redness but not blistering;⁸¹⁸ contact with the eyes, nose, lips, or other mucous membranes causes burning that does no harm but is extremely uncomfortable while it lasts.

The generic circumscription of *Capsicum* is unclear. Most botanists agree that the presence of the pungent capsaicin characterizes the genus, but some nonpungent types of peppers exist. Other generic characters useful for recognizing *Capsicum* are the wheel-shaped or bell-shaped corollas with very short lobes; free, glabrous filaments; shiny, nonpulpy berries; and herbaceous habit.^{601,694,862} The taxonomy of *Capsicum* at and below the species level is in a state of flux, complicated by the existence of wild, domesticated, and weedy forms that may interbreed. It is now known that several wild species gave rise to the domesticated capsicums, and that there are probably several centers of domestication in the New World. In general, the wild species are self-incompatible and bear erect, small, red, pungent fruits that separate from the calyx at maturity. It is reported that the fruits are adapted for dispersal by birds, but this has not been confirmed. The domesticated species are generally self-compatible, with erect or pendent, nondeciduous fruits that vary considerably in shape, size, and color. Cultivated forms often have more than 5 corolla lobes. A beautifully illustrated volume covering all aspects of chili peppers is *Peppers: The Domesticated Capsicums*.²³ At least two domesticated species are grown in Hawai'i, but by far the most common is *C. annuum*.

Pepper plants are easily grown where there is abundant moisture and good drainage.¹⁴³⁹ They are often grown as annuals, although the plants are perennial in suitable climates. Peppers grow best under cool temperatures (65–75°F); in the Hawaiian lowlands, they should be planted in late fall and winter and harvested in late winter or early spring. They host a variety of pests

and diseases, most of which can be controlled by chemical sprays; peppers should not, however, be planted in areas where bacterial wilt pathogens are present, for there are no chemical controls or resistant varieties. Peppers are propagated by seed or by seedlings purchased from nurseries or garden centers.

Capsicum annuum Linnaeus [Syn.: *C. chinense* N. Jacquin, *C. frutescens* Linnaeus, *C. sinense* N. Jacquin], PEPPER; C: LAAT JIU, TSENG JIU; H: NŌI, NŌI PEPA; J: KARASHI; P: SILI; TH: PRIK

Flws and frt 1 to several per node; cal entire or with short teeth; cor milky white or greenish white (occasionally purple), without spots at bases of lobes; anth blue to purple before opening. Frt erect or pendent, flesh firm or soft. Seeds light yellow.

As circumscribed here, *C. annuum* includes *C. chinense* and *C. frutescens*, which are considered by some taxonomists to be distinct species. They are all closely related, and the morphological characters used to distinguish them are inconsistent and obscure. Accordingly, only one species is recognized here, which perhaps should better be called the "*C. annuum* complex."

Capsicum annuum is the most commonly cultivated species of pepper and includes a multitude of forms. Wild and domesticated types can be recognized and have been given formal taxonomic rank by some pepper experts, but it is probably more useful to refer to the wild and domesticated types, chromosome races, and so forth by informal, nontaxonomic categories.¹¹⁴⁵ Wild peppers have small, erect, pungent, red to orange-red fruit, mostly less than 1" long and 0.5" in diameter. They grow spontaneously in the southern U.S., Mexico, Central America, the West Indies, and northern South America and are often known as CHILIPQUINS or BIRD PEPPERS. Chilis were planted by Don Francisco de Paula Marin in Hawai'i as early as 1813.¹⁰¹⁰ Feral forms have also escaped from cultivation in Hawai'i, especially in disturbed areas at low elevations.¹⁵³²

The domesticated selections of *C. annuum* include a vast number of horticultural cultivars that vary greatly in fruit shape,

size, and color. Fruit can range in length from less than 0.5" to more than 12", in shape from small and conical to large and blocky, and in color from yellow, red, and green to brown and purple. Pungent and nonpungent types exist, as well as types with erect or pendent fruit. They are grown for culinary use and as ornamentals. Five main cultivar groups, all represented in Hawai'i, are generally recognized for the cultivated selections of *C. annuum*.^{698,853,891}

Among the cultivars of *C. annuum* likely to be encountered in home gardens are the BELL PEPPERS, in Tagalog SILI BERDE, in Hawaiian NŌI PUHA'UHA'U or NŌI'ALU'ALU, in Korean PIMAN, a mild-flavored, large-fruited group of cultivars with green, yellow, orange, or red fruits that are eaten raw in salads or as snacks or cooked as vegetables and seasonings. Considerably more pungent are the CAYENNE, CHILI, and TABASCO peppers, AJI in Mexican Spanish, whose dried, ground fruits are the spices (red pepper, chili pepper, cayenne) sold commercially; the "Hawaiian pepper," used to make chili pepper water and grown in the Islands since at least 1815¹⁰⁵² may belong in this group. Milder though still somewhat pungent peppers include PIMIENTO and PAPRIKA. A considerable number of cultivars with no English common names from Southeast Asia, the Philippines, and Latin America have been introduced to Hawai'i over the last decades of the twentieth century.

Capsicum baccatum Linnaeus

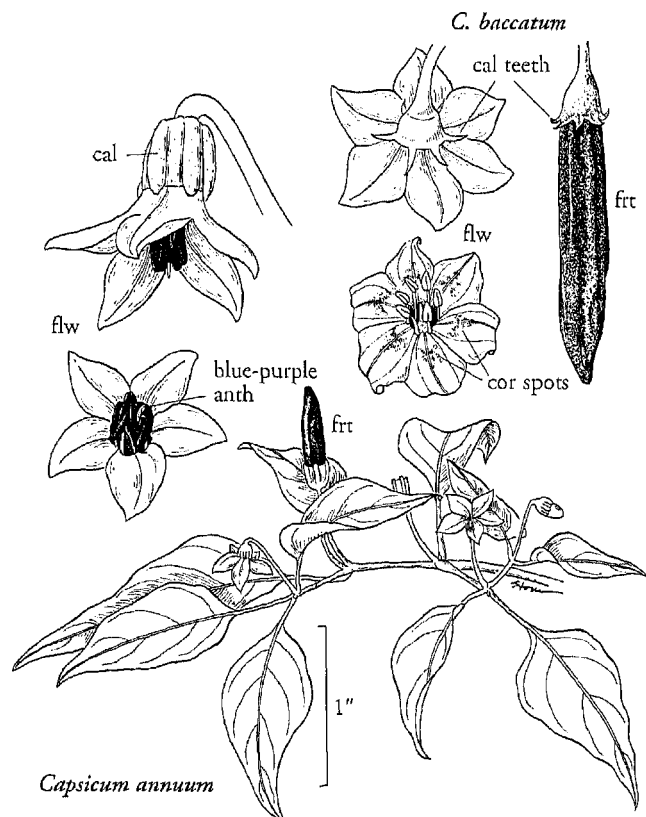
Flws and frt 1 to several per node; cal with veins prolonged into prominent teeth; cor white or greenish yellow, with yellowish or tan spots at bases of lobes; anth yellow before opening. Frt erect or pendent, flesh firm. Seeds light yellow.

This species has been divided into two taxonomic varieties: the wild var. *baccatum*, distributed throughout southern Peru, Bolivia, northern Argentina, Paraguay, and Brazil; and the cultivated var. *pendulum* (Willdenow) Eshbaugh [Syn.: *C. pendulum* Willdenow], grown in western South America and also introduced to Hawai'i.^{396,397} The wild variety resembles the cultivated types except that the fruits are small, red, erect, and deciduous and present in clusters of 1 to several per node. The cultivated var. *pendulum* has red, orange, yellow, green, or brown fruits that are pendent, persistent, and borne singly;³⁹⁶ the corolla is also larger than that of var. *baccatum* and the fruits are usually much larger. *Capsicum baccatum* var. *pendulum* was most likely domesticated in lowland tropical Bolivia. It is grown from sea level to 5,000' from northern Argentina to northern Colombia and is especially prevalent along the western coast of South America. It is now cultivated in Europe, India, Japan, Guatemala, and Hawai'i, and perhaps in Mexico and other Central American countries. It was introduced to Hawai'i by 1951, where it was grown under the name "Brown's pepper."¹¹⁵⁵

Capsicum baccatum is less often cultivated here than the many forms of *C. annuum*, but one cultivar is grown and sold for making Korean *kim-chee*. Its dark green fruits are 2.5–3" long, tapering-conical, and mildly pungent. The plants are more robust than those of *C. annuum*, with larger leaves and flowers, besides possessing the characters mentioned above.

CESTRUM Linnaeus (Gk. *kestron*, a plant name Linnaeus freely associated with this genus)

Shrubs or treelets, glabrous or hairs simple, forked, or tree-shaped. Lvs alternate or paired, simple, petiolate; blades entire. Infl panicle- or raceme-like; bracts often present. Flw cal tubular, 5(–7)-lobed, persistent; cor tubular or salver-shaped, often slightly bilaterally symmetrical, <2" long, apex usu 5-lobed, lobes much shorter than tube; stam 5, included, anth opening by lengthwise slits; ovary 2-celled. Frt a berry, glabrous, fleshy. Seeds few, ovoid or angled.



Cestrum includes some 150–250 species native to tropical America, several of which are grown as ornamentals for their fragrant flowers. Most species contain alkaloids and several are known to cause livestock and human poisoning if the berries or any part of the plant is eaten.^{57,101A,102A}

Cestrum are rather unobtrusive plants in the landscape, with neither foliage nor flowers particularly eye-catching. Their fragrance is their greatest asset. Placement must be considered carefully before the shrubs are planted—not too close to houses or

windows, where the odor could be overpowering. One or two in a mixed shrub border, hedge, or background planting is adequate for the average-sized garden; more than that risks too much of a good thing. The shrubs tend to be lanky and require pruning to develop an attractive shape. Otherwise, cestrum are hardy and adaptable and require little care in our climate.

Numerous *Cestrum* species are grown in botanical gardens and arboreta in Hawai'i,²⁰¹ but only four are likely to be encountered in home gardens.

Key to *Cestrum*

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|-------|---|-----------------------|
| 1. | Lvs and stems pubescent | <i>C. elegans</i> |
| 1. | Lvs and stems glabrous or nearly so (2). | |
| 2(1). | Cor orange-yellow | <i>C. aurantiacum</i> |
| 2. | Cor white or greenish yellow (3). | |
| 3(2). | Cor greenish yellow; fil with erect appendage where attached to cor tube; frt white | <i>C. nocturnum</i> |
| 3. | Cor white; fil swollen at point of attachment but not appendaged; frt black | <i>C. diurnum</i> |

Cestrum diurnum Linnaeus, CHINESE INKBERRY, DAY CESTRUM, DAY-JESSAMINE; H: MĀKĀHALA

Shrub to ca 10' tall, mostly glabrous (some woolly hairs in lf axils on young growth and infl). Lf peti 0.25–0.5" long; blades elliptic, 2–5" × 1–2", base rounded or tapered, apex obtuse or acute. Infl peduncles to ca 2" long; pedicels <0.1" long. Flws fragrant by day; cal ca 0.125" long; cor white, tube ca 0.5" long, lobes reflexed; fil swollen but not appendaged at point of attachment, free part <0.1" long. Frt globose or ellipsoid, 0.25–0.3" long, black. (see p. 529)

Originally from the West Indies, *C. diurnum* is cultivated as an ornamental for its flowers, which are sweetly fragrant during the day; it was introduced to the Islands before 1871.⁶³⁵ Day cestrum is less often cultivated here than night cestrum. The glossy black fruit is eaten by birds,¹⁰⁵² and so cestrum has escaped cultivation and is naturalized on several Islands.¹⁵³² The flowers are sometimes used in homemade leis but not commercially.⁹⁴³ Day cestrum is cultivated and propagated like night cestrum.

Cestrum nocturnum Linnaeus, CHINESE INKBERRY, NIGHT CESTRUM, NIGHT-JESSAMINE; H: 'ALAAUMOE, KŪPAOA, ONAONA IĀPANA

Shrub 6–12' tall, ±glabrous. Lf peti ≤0.5" long; blades elliptic, 3–6" × 1–2", base rounded or tapered, apex acute or tapering. Infl peduncles often ≤1" long; pedicels to 0.125" long. Flws fragrant at night; cal ca 0.125" long; cor yellow-green, tube 0.5–1" long, lobes erect or spreading; fil with erect appendage at point of attachment. Frt ellipsoid, 0.25–0.5" long, white.

Cestrum nocturnum is native to Central America and the West Indies. It is frequently cultivated for its flowers, which become strongly fragrant at night, so much so that some find the scent overpowering, causing headaches, sneezing, and even nausea.¹⁰¹³ Although the leaves and fruit are used medicinally in Mexico,¹⁰¹² they are reputedly poisonous to livestock and should not be eaten by humans. The flowers are sometimes used for home lei making.⁹⁴³ Night cestrum has escaped from cultivation and become naturalized in wet areas on Kaua'i and O'ahu.¹⁵³²

Night cestrum is a fast-growing and adaptable species and grows almost anywhere in Hawai'i except on beaches or salt-exposed areas. It has been suggested as moderately drought tolerant and therefore suitable for xeriscape use in southern Florida.¹³⁷¹ Scale insects, thrips, and red spider mites may attack the foliage; these are rarely serious pests for healthy plants, but

chemical controls are available if the infestation is severe. Pruning is required to shape the naturally loose, open growth form into an attractive, dense crown. After flowering, the shrubs should be pruned back to about 3' from the ground and fertilized heavily to encourage vigorous new shoots that will bear flowers the following season.²¹¹ Night cestrum is usually propagated by cuttings or seed.

Other *Cestrum*

Two other cestrum are grown in our gardens; they lack the intense fragrance of the more common species.

Cestrum aurantiacum Lindley, ORANGE CESTRUM, or MĀKĀHALA in Hawaiian, native to Mexico and Central America, is occasionally grown for its attractive flowers. It differs from the above-mentioned species in its broader leaves, longer calyx with narrow, pointed lobes, and orange-yellow corollas. The night-fragrant flowers are used for leis and are said to be preferred over other *Cestrum* species because of their golden orange color.^{943,1052}

Cestrum elegans (Neumann) Schlechtendal is sparingly cultivated in Hawai'i. It can be distinguished by its pubescent leaves and stems, dark red or purple corollas with the tube inflated below the lobes, reddish berries, and somewhat climbing habit. It is native to Mexico.

PETUNIA A. L. Jussieu (from *petun* or *petum*, an aboriginal Brazilian name for tobacco)

Annual or perennial herbs, ±glandular-hairy. Lvs alternate, simple, usu sessile; blades entire. Infl raceme-like or flws solitary; bracts paired, equal, leaflike. Flws usu slightly bilaterally symmetrical; cal bell-shaped, 5-parted; cor tubular, salver-shaped, or funnel-shaped, 5-lobed; stam 5, 4 in 2 pairs, 1 shorter, anth opening by lengthwise slits; ovary 2-celled. Frt a dry, 2-valved capsule. Seeds globose, often angled, <0.1" long.

The genus *Petunia* contains 30–40 species, mostly native to South America, with one species found in northern Mexico and the southern U.S. *Petunia* is similar to the genus *Nicotiana* but differs by its paired bracts in the inflorescence, calyx segments free nearly to the base, corolla mouth not as constricted, capsule dehiscent by 2 apical valves, and different chromosome number. Several species including *Petunia axillaris* (Lamarck) Britton, Sterns & Poggenburg and *P. ×hybrida* are grown as ornamentals, with the latter the most common in cultivation.

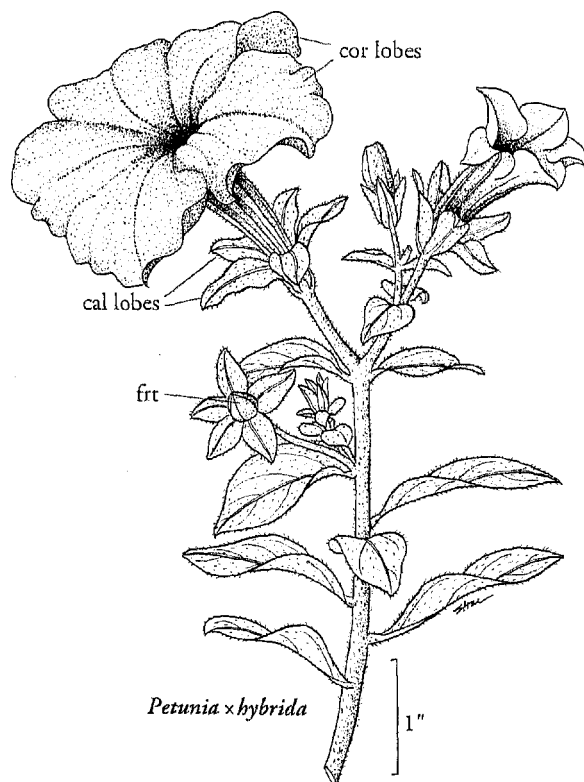
Petunia ×hybrida (J. D. Hooker) Vilmorin [Misapplied: *P. violacea*], PETUNIA

Erect or sprawling herb, densely glandular-pubescent. Lf peti short or none; blades ovate, elliptic, or obovate, 0.5–2.5" long, base tapered. Infl with leaflike bracts 0.25–1" long. Flws usu fragrant; cal lobed nearly to base, lobes oblong, usu green and leaflike; cor white or colored, funnel-shaped, tube 0.5–2.5" long, gradually widened into 5-lobed limb, >1" Ø; fil attached below middle of cor tube. Capsule 0.25–0.75" long, glabrous.

Petunia is a commonly cultivated garden ornamental that varies widely in flower form and color. *Petunia ×hybrida* arose in cultivation, derived from the South American species *P. axillaris* and *P. integrifolia* (W. J. Hooker) Schinz & Thellung [Syn.: *P. violacea* Lindley] and encompassing a complex of hybrids between them.¹⁴²³

The short stature and ease of cultivation of petunias make them ideal bedding or container plants. They require frequent watering and cannot tolerate salt but are otherwise unexacting in their horticultural requirements. A multitude of cultivars exist: solid colors, bicolors, single flowers, doubled flowers, frilled and ruffled corolla edges, dwarf plants, large sprawling ones, and various combinations of these traits. Many selections are sold through mail-order seed catalogs or as young plants in nurseries.

In Hawai'i, petunias are grown as winter bedding annuals and in containers such as window boxes, planters, and hanging baskets. They are often incorporated in landscaping at service stations and other businesses for the splash of color they provide. Adaptable and easy to care for, petunias need little special care: full sun, ample water, a fertile yet well-drained soil, and protection from salt spray and strong winds. Viral diseases affect petunias, as they do many Solanaceae; infected plants must be destroyed, for there is no treatment. Pests such as root-knot nematode, scale insects, spider mites, and beetles may attack the plants; chemical controls are available if the problem is severe, but plants are short-lived and usually replaced each season. Most plants are purchased as seedlings in flats or trays, although seeds and cuttings are also options for the home grower. The tiny seeds have special requirements for successful germination.⁴⁰⁰



PHYSALIS Linnaeus (Gk. *physa*, bladder, alluding to the inflated calyx), GROUND-CHERRY, HUSK-TOMATO

Annual or perennial herbs, rarely shrubs, glabrous or hairs simple, branched, or glandular. Lvs alternate or paired, simple; blade margins entire or toothed. Flw usu solitary, nodding, axillary; cal bell-shaped, 5-lobed, greatly enlarging in frt; cor bell- to wheel-shaped, often 5–10-lobed, usu yellowish, or whitish or bluish, base often darker-spotted; stam 5, fil ±unequal, anth yellowish or bluish, opening by lengthwise slits; ovary 2-celled. Frt a berry, usu glabrous (or sticky-glandular), completely enclosed by cal. Seeds numerous, flattened.

Physalis is a genus of about 80 species, the majority from the New World, with a few Old World representatives. Several species are cultivated for their edible fruit. The perennial herbaceous species often produce underground rhizomes, by which they are able to spread extensively. *Physalis alkekengi* Linnaeus, Chinese-lantern plant, is grown as an ornamental in Europe and North America for its red inflated calyxes.

Ground-cherries are easy to grow given warm, sunny conditions. They are propagated by seeds, shoot cuttings, or (in perennial species) division of rhizomes.

Physalis peruviana Linnaeus, CAPE-GOOSEBERRY, GOLDEN BERRY; H: PA'INA, POHĀ; J: HOZUKI

Herb or shrub, densely pubescent with simple or glandular hairs. Lf blades ovate, 2–4" long, base truncate to cordate. Flw cal ca 0.25" long, lobed ±halfway into 5 pointed lobes; cor 0.5–1" Ø, wheel-shaped to shallowly 10-lobed, yellow, base with purple-brown blotches; anth bluish before opening, not twisted after opening. Berry globose, 0.5–1" Ø, yellow-orange, enclosed in inflated, angled, tan, 1–1.5" long cal. Seeds ca 0.125" long, light brown. (see p. 529)

Physalis peruviana is most likely a native of Andean South America, but its wild relatives and place of origin are not known.¹⁰⁴⁴ It is now grown worldwide as a minor fruit crop. The berries are eaten raw or cooked and are frequently made into jam. Pohā is a small-scale commercial crop in Hawai'i, Australia, New Zealand, and South Africa.²¹⁰ It was introduced early to Hawai'i, having been observed in 1825 by Andrew Bloxham, naturalist aboard the HMS *Blonde*,¹⁰⁴⁴ and has since become naturalized on several Islands, especially at elevations between 1,500' and 4,000'.¹⁰⁵² The fruits are strung for leis and have been popular with Big Island cowboys because they are long lasting when worn as hat leis.⁹⁴³ The foliage and possibly the unripe green fruits are toxic because of the presence of solanine.⁵⁷

Pohā is suitable for home cultivation by gardeners living upcountry, where conditions are better suited for the plants. Although it grows vigorously near sea level, fruit production is much better above 1,500' elevation. A mature plant may spread horizontally 6–8' but usually gets no more than 3' high.

Pohā grows best in full sunlight in well-drained soils with a pH between 5.0 and 6.5.²¹⁰ Overly fertile soils may encourage vegetative growth rather than fruit production. Supplementing nutrient-poor soils with 10-30-10 fertilizer at planting and 5-10-10 or 10-20-20 at two-week intervals thereafter benefits fruit production. Pohā is a perennial in our climate, and plants produce fruit for more than one year. Plants are usually started in flats; young seedlings can be transplanted about seven weeks after sowing, and fruit matures three to five months after transplanting. After the first crop is harvested, plants may be cut back severely and fertilized to induce a flush of growth; commercial fields are replanted after the second crop is harvested. The fruit is ready for picking when the husks are dry and yellowish brown; it may be picked from the plants or allowed to fall off and collected from the ground. Pohā is subject to attack by various insect pests and fungal, bacterial, and viral diseases. Propagation is usually by seed, although 6–8" stem cuttings can also be used.

Other *Physalis*

Physalis philadelphica Lamarck [Misapplied: *P. ixocarpa* Hornemann], TOMATILLO, is native to Mexico and Central America.⁶⁸² It is often used in Mexican cooking and is a frequent offering in specialty produce sections of mainland U.S. grocery stores. At present it is only rarely cultivated in Hawai'i. It differs from *P. peruviana* in that the plants are glabrous or nearly so, the leaves are tapered rather than cordate at the base, and the anthers are twisted after opening. The berries are occasionally eaten raw but are more commonly cooked to make sauces, such as the *salsa verde* of Mexican cuisine. The flowers are reported to be self-incompatible.

SOLANDRA Swartz (honors D. C. Solander, 1733–1782, Swedish botanist who accompanied Capt. James Cook on the voyage of the *Endeavour*)

Unarmed woody climbers; stems mostly glabrous. Lvs alternate, simple; blades usu leathery, entire. Infl terminal, of few-flwd clusters or flw solitary. Flw cal tubular, splitting irregularly; cor goblet-, bowl-, or funnel-shaped, often >4" long, lobes 5, edges overlapping in bud; stam 5, anth opening by lengthwise slits; ovary 4-celled, half-inferior. Frt a leathery berry, loosely enclosed by cal. Seeds flattened.

Solandra includes 10 species native to tropical America. All are climbers found in tropical rainforests at elevations of 1,600' to 10,000'.¹⁰⁰ At least three species are cultivated as ornamentals for their showy flowers. Several species are used as ritual hallucinogens in Mexico, reflecting their alkaloid content, and the plants are poisonous for the same reason.^{57,100,923,101,1,100}

Solandras do not set fruit often and are usually propagated by stem cuttings. One species is commonly cultivated in Hawai'i.

Solandra maxima (Sessé & Moçiffo) P. S. Green [Syn.: *S. hartwegii* N. E. Brown; Misapplied: *S. grandiflora*, *S. guttata*, *S. nitida*], CHALICE VINE, COPA-DE-ORO, CUP-OF-GOLD, GOLDEN-CUP

Climbing or scrambling shrub. Lf peti 1–3" long; blades elliptic, to ca 6" long, glabrous, base tapered. Flw cal glabrous, 2–4" long, splitting into 3–5 pointed lobes; cor goblet- or cup-shaped, yellow, darkening with age, 5 greenish ribs outside, 5 or 10 purplish ribs inside, tube 6–8" long, abruptly widened into cuplike throat 3–6" Ø, lobes entire, undulate, or fringed; fil attached 3–4" from cor base, anth 0.25–0.5" long. Frt ovoid, smooth. (see p. 529)

Solandra maxima is native to Mexico, Central America, and northern South America. This beautiful vine is often grown as an ornamental for its gigantic yellowish flowers, which become fragrant at night and may (in their homeland) attract bats as pollinators. The leathery fruit is said to be edible.⁹²³ Toxic alkaloids have been isolated from the roots and aerial parts, and this species was one of the Aztec ritual hallucinogenic plants.¹⁰⁰

The large size of this climber limits its usefulness to the largest gardens or spacious estates. In the past, chalice vine was

often planted along roadsides and on barren hills or banks for beautification; plants are more likely to be seen in such places today than in home gardens because they are just too large for the average backyard. The floral fragrance, like that of many bat-pollinated species, is more musty than sweet and some people find it unpleasant. *Solandra maxima* sometimes persists after cultivation, but it is apparently not naturalized in Hawai'i.¹⁵³² Feral populations, though extensive, do not appear to set seed and spread farther, perhaps because of lack of a suitable pollinator.

In Hawai'i chalice vine usually flowers in January, February, and March, at which time it is highly visible and attracts comment;¹⁰⁵² at other times of the year the plant tends to blend into the background vegetation. Hardy and adaptable, it can thrive with almost no care in sunny, drier habitats on nutrient-poor, well-drained soils, but it does even better when provided with water, fertilizer, and judicious pruning to control and shape its rampant growth. A low-nitrogen fertilizer is recommended, lest foliage be produced at the expense of flowers.⁴⁰⁰ Ample space and a stout support are needed for the stems to climb on or sprawl over. Chalice vine is easily propagated from cuttings; seed is rarely produced.

SOLANUM Linnaeus (Lat. *solamen*, quieting, supposedly alluding to the sedative qualities of some species) [Syn.: *Lycopersicon* P. Miller], NIGHTSHADE

Herbs, shrubs, treelets, or climbers, glabrous or hairs simple, glandular, branched, or star-shaped, sometimes prickly. Lvs alternate or paired, simple or pinnately compound; blades entire, toothed, or lobed. Infl axillary or extra-axillary. Flws usu radially symmetrical, usu bisexual, usu 5(4–6+)-parted; cal 5-lobed; cor star- to wheel-shaped, often purple, blue, or white (or yellow); stam 5, anth opening by terminal pores (sometimes lengthening to slits); ovary usu 2-celled. Frt a berry, sometimes partly enclosed by cal. Seeds usu flattened.

Solanum is one of the largest genera of flowering plants, with an estimated 1,500–2,000 species. The genus is worldwide in distribution, with the greatest number of species found in tropical America. The family includes important food plants such as potato, tomato, and eggplant, all grown in the Islands, as well as a number of lesser-known tropical fruits. Steroidal alkaloids are prevalent in the genus, and some species have been grown as sources of solasodine for corticosteroid drugs. Many species are toxic because of this alkaloid content; others are noxious weeds. For the size of the genus, comparatively few species are of ornamental importance.

Solanums are adaptable and easy to grow. Those described here can all be cultivated much like tomatoes or eggplants. Herbaceous solanums are usually propagated from seed; woody or semiwoody species may be started from cuttings as well.

Many species of *Solanum* are grown in botanical gardens and arboreta in Hawai'i,⁷⁰¹ but only 13 species are likely to be seen in home gardens.

Key to *Solanum*

1. Woody climbers; lvs and stems nearly glabrous; lvs usu pinnately lobed (2).
1. Herbs or shrubs; lvs and stems glabrous or pubescent; lvs simple or pinnately compound (3).
- 2(1). Lvs and stems often with recurved prickles; cor shallowly lobed *S. wendlandii*
2. Lvs and stems without prickles; cor deeply lobed *S. safforthianum*
- 3(1). Anth with narrow sterile tips, joined around style into flask-shaped structure; lvs pinnately compound with reduced lfts between larger ones; cor yellow *S. lycopersicum*
3. Anth without sterile tips, joined or not; lvs simple or compound; cor blue, purple, pink, white, or greenish (4).
- 4(3). Plants glabrous or with simple or forked (not star-shaped) hairs; prickles absent; anth usu not much tapered (5).
4. Plants with star-shaped hairs or prickles (simple hairs may also be present); anth usu strongly tapered (8).

- 5(4). Tuber-bearing herbaceous perennials; pedicels jointed above middle; lvs pinnately compound, often with reduced lflets *S. tuberosum*
5. Plants without tubers; pedicels jointed at base; lvs mostly simple, rarely compound, without reduced lflets (6).
- 6(5). Cor ca 0.2" Ø; ripe frt shiny black *S. americanum*
6. Cor 0.3" or more Ø; ripe frt red, orange, yellow, green, or white (7).
- 7(6). Cor white; ripe frt erect, red or orange *S. pseudocapsicum*
7. Cor whitish or purplish; ripe frt pendent, yellow, green, or white with purple stripes *S. muricatum*
- 8(4). All hairs unbranched (9).
8. At least some star-shaped hairs present (10).
- 9(8). Seeds bordered by prominent wing; frt red, globose; cor white; cal prickly *S. capsicoides*
9. Seeds without wing; frt yellow-orange, often lobed at base; cor pale blue-purple; cal without prickles *S. mammosum*
- 10(8). Infl usu branched, >10-flwd (11).
10. Infl unbranched, usu <10-flwd (12).
- 11(10). Cor white, ca 1" Ø; frt 0.5–1" Ø *S. torvum*
11. Cor blue or purple, fading to white, ca 2" Ø; frt 1.5–2" Ø *S. wrightii*
- 12(10). Cor whitish; frt yellow or orange; pulp green *S. quitoense*
12. Cor purple or white; frt green, purple, white, rarely yellow-orange; pulp white or yellowish *S. melongena*

Solanum capsicoides Allioni [Syn.: *S. ciliatum* Lamarck; Misapplied: *S. aculeatissimum*], COCKROACH BERRY, RED PŌPOLO; H: AKAKA, AKAKA, KĪKĀNIA LEI

Shrub to 3' tall, ±pubescent with simple, often glandular hairs, prickly. Lf peti to 3" long; blades broadly ovate, to 6" long, base truncate to cordate, margins coarsely toothed or lobed. Infl 2–5-flwd, unbranched. Flw cal prickly, deeply 5-lobed, ±enlarging in frt; cor 0.5–1.5" Ø, deeply 5-lobed, white, lobes glabrous; stam equal, anth ca 0.25" long, apex tapered. Frt globose, 0.75–1.5" Ø, red, glabrous. Seeds prominently winged, yellowish or light brown. (see p. 537)

Solanum capsicoides is native to coastal Brazil but is now a widespread weed in tropical regions of the world. The fruit is reputed to be poisonous to livestock¹²⁴ and has been used like *S. mammosum* as a cockroach poison.¹⁰⁸ Despite its apparent toxicity, the roasted fruit is eaten and various plant parts used medicinally in the East Indies.¹⁷⁵ All parts of the plant should be considered poisonous.⁵⁷ *Solanum capsicoides* was first collected on O'ahu in 1837 and has now become naturalized on most of the larger islands in Hawai'i.¹⁵³²

Kīkānia lei is occasionally cultivated for its attractive red or orange fruit, which can be strung into long-lasting leis that are considered appropriate for men.^{943,1052} The species is widely considered a weed.

Solanum lycopersicum Linnaeus [Syn.: *Lycopersicon esculentum* P. Miller, *L. lycopersicum* (Linnaeus) H. Karsten], TOMATO; C: FAAN KĒI; H: KAMAĀKO, 'ŌHI'A LOMI; P: KAMATIS; TH: MA KHUE TEO

Pubescent herb with simple or glandular hairs. Lvs pinnately lobed or compound, usu with reduced lflets between larger ones; lflets entire or lobed; false stipules absent. Infl usu many-flwd, pedicels jointed at or above middle; bracts absent. Flw cal deeply 5-lobed; cor 5(–9)-lobed, star-shaped, yellow, tube short; anth joined around style in flask-shaped structure, apexes with narrow, sterile tips. Frt glabrous, red or yellow, >0.5" Ø.

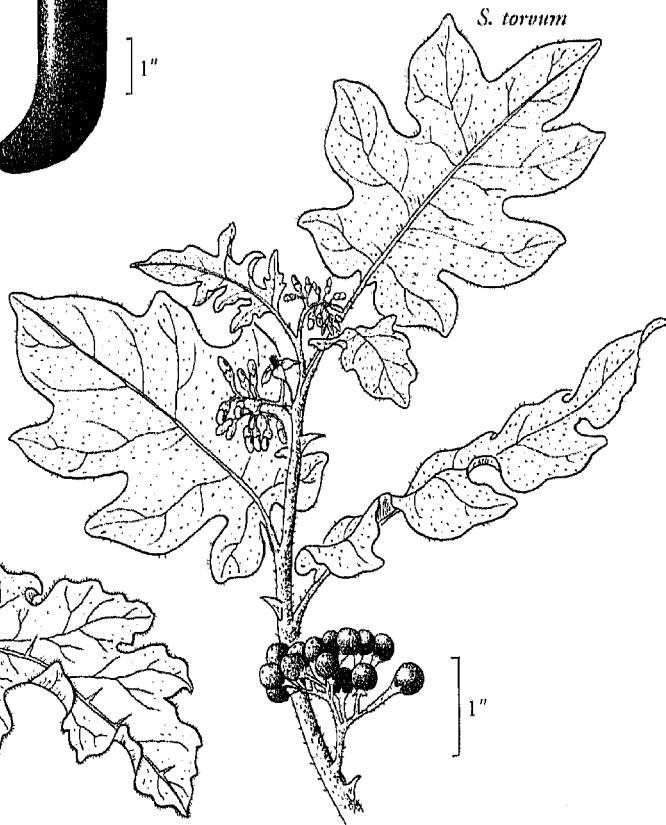
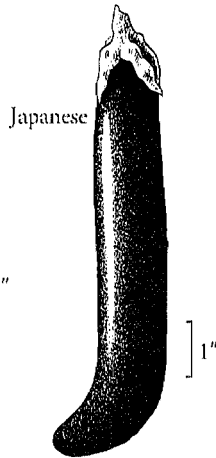
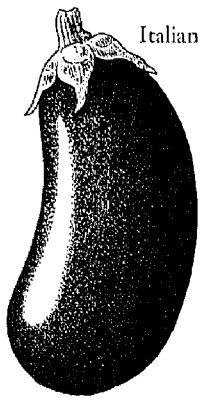
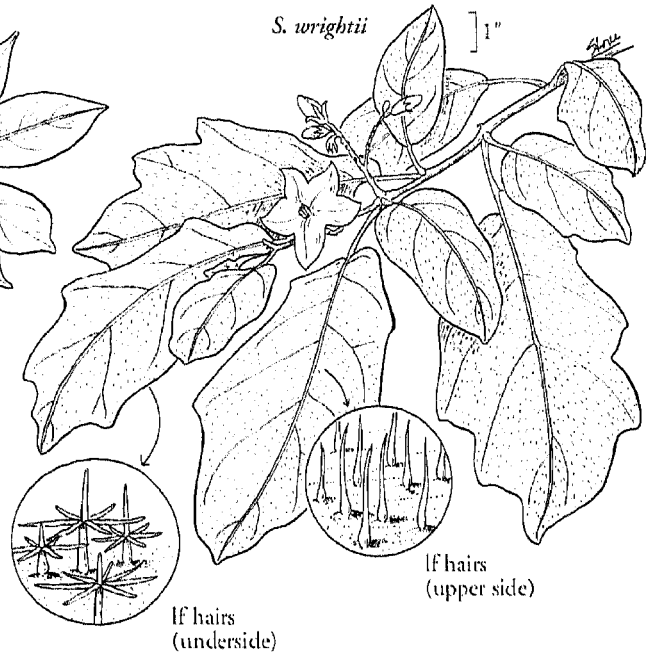
Tomatoes and their close relatives are a group of about 10 species native to western South America and the Galapagos Islands. This group was formerly recognized as a separate genus, *Lycopersicon* P. Miller, distinguished from *Solanum* by the yellow flowers with sterile anther beaks. Recent studies have shown that the genus *Lycopersicon* should be included within *Solanum*, and the transfer of *Lycopersicon* names to *Solanum* was made in 1993.¹³⁷⁶

Tomatoes are grown throughout the world for their fruit, which is eaten raw or made into sauces, ketchups, soups, and juices. They may escape from cultivation and become weedy. Their seeds pass unharmed through the digestive tracts of many animals, including humans, and may germinate near sewage dumps or in fields fertilized with manure. The foliage of tomatoes, like that of many other species of Solanaceae, contains poisonous alkaloids and should not be eaten.⁵⁷

Two varieties of *S. lycopersicum* are commonly recognized: var. **lycopersicum**, the large-fruited, many-celled commercial tomato; and var. **cerasiforme** (Dunal) Spooner, G. J. Anderson & R. K. Jansen [Misapplied: *S. pimpinellifolium*], CHERRY TOMATO, in Hawaiian 'ŌHI'A MA KA NAHELE. This latter variety is distinguished by its smaller (usually 0.5–1" in diameter), 2-celled fruit. It grows spontaneously in tropical and subtropical regions of the world and is thought to be the most likely ancestor of the cultivated tomato.¹²³² Cherry tomatoes are widely cultivated and have become naturalized on O'ahu, Kaua'i, Lāna'i, and outlying islands. PLUM TOMATO is a form of var. *lycopersicum* with elongated, oval fruit. Although all wild tomato species are native to South America, domestication of *S. lycopersicum* is thought to have taken place in Mexico.⁷²⁶

Don Francisco de Paula Marin planted tomatoes in his garden in 1817.¹⁰¹⁰ Hawaiian plants identified as *Lycopersicon pimpinellifolium* (Juslenius) P. Miller (now called *S. pimpinellifolium* Juslenius) in the *Manual of the Flowering Plants of Hawai'i*¹⁵³² are actually *S. lycopersicum* var. *cerasiforme*.¹⁵³³ The two species are rather difficult to distinguish, but *S. pimpinellifolium* has very small fruit (less than 0.5" in diameter), finely pubescent stems and leaves, undulate or entire leaflet margins, a more slender habit, and elongate inflorescences.^{881,1024,1231} It remains to be seen whether true *S. pimpinellifolium* is actually present in Hawai'i.

Tomatoes are easily grown in household gardens; to thrive they need abundant sunlight and water, warm temperatures, good drainage, and an organically enriched, well-tilled soil with a pH between 5.5 and 7.0.⁵⁰² Plants may be staked and tied, confined in metal wire cages, allowed to sprawl on the ground, or grown in individual 3- to 5-gallon containers; the first method is usually preferred by the home grower, although gardeners with limited space are increasingly opting for dwarf plants grown in containers. The plants should be watered one to three times a week, giving the soil a deep, thorough soaking; the leaves



should not be wetted, since this encourages fungal diseases. Container-grown plants may need daily watering. The cultivated tomato is self-fertile, the flowers capable of self-pollination. Numerous insects attack tomato vines and fruit, including whiteflies, leaf miners, planthoppers, and melon flies. Specially formulated tomato sprays, general-purpose insecticides, and biological control agents are available to control these pests; bagging the fruit clusters with paper or soft cloth bags protects them from stinging by melon flies. Tomato is susceptible to attack by root-knot nematodes and several viral and fungal diseases such as verticillium wilt, fusarium wilt, and anthracnose. Cultivars resistant to these diseases have been developed in Hawai'i and are better adapted to our growing conditions; among those recommended are the F-1 hybrids N-5, N-52, N-65, and N-69 as well as the cultivars 'Anahu', 'Healani', 'Kalohi', and 'Puunui'. The F-1 hybrids are better suited for stake-and-tie culture. Alternatively, fungicides may be used to control blight, especially during wet weather or high humidity conditions. Tomatoes are propagated by seed or by purchasing seedlings at a nursery or garden supply center; cuttings root readily but are rarely used.

***Solanum mammosum* Linnaeus, NIPPLE FRUIT**

Herb or shrub to 3' tall, prickly, pubescent with simple, often glandular hairs. Lf peti 1.5–4" long; blades broadly ovate, 2.5–8" long, base truncate to cordate, margin coarsely toothed and lobed. Infl 1–4-flwd, unbranched. Flw cal pubescent, not prickly, deeply 5-lobed; cor 1–1.5" Ø, deeply 5-lobed, pale blue-purple, hairy outside; stam equal, anth narrow, 0.25–0.5" long, apex tapered. Frt ovoid, 1–3" long, orange-yellow, glabrous, base with nipplelike lobes. Seeds not winged, dark brown. (see p. 537)

A native of tropical America, *S. mammosum* is sometimes cultivated as an ornamental for its bizarre fruit, which is reputed to be poisonous and is sometimes used to kill roaches.⁴²⁹ It is cultivated much like eggplant.

***Solanum melongena* Linnaeus [Syn.: *S. esculentum* Dunal],**

AUBERGINE, BRINJAL, EGGPLANT; C: AI GUA, AI KWA;

H: LAHOPIPI; J: NASU; K: KAJI; P: TALONG, TALONG BILOG;

TH: MA KHUEA

Herb or shrub to 6' tall, prickly or not, hairs star-shaped. Lf simple; peti to 3" long; blades ovate or elliptic, to 9" long, base truncate, often unequal-sided, margins entire or shallowly 5–9-lobed. Infl unbranched, 1- or few-flwd. Flw cal pubescent, ca 0.5" long, 5-parted; cor 1–2" Ø, white or purple, 5–7-lobed, backs of lobes hairy; stam equal, anth ca 0.25" long, apex tapered. Frt variable: globose, obovoid, or oblong, glabrous, skin dark purple, pale green, yellow, or white, flesh white or yellowish. Seeds flattened, light brown. (see p. 537)

Eggplant was probably first domesticated in India and is now cultivated as a vegetable in most warmer parts of the world. It was introduced to Hawai'i before 1824.¹⁰³⁴ Domesticated forms of *S. melongena* usually lack spines. Many cultivars exist, with great variation in fruit size, shape, and color. Some cultivars bear white, ovoid fruit that resembles chicken eggs, hence the common name. In addition to their use as food, various parts of the plant are used medicinally in China, Southeast Asia, and the Philippines.¹¹³³ All parts of the plant except the fruit are toxic.^{57,578}

In Hawai'i, three distinct fruit types are cultivated for food, and others are grown as ornamentals. The Japanese-type eggplant has elongate, slender fruit, usually 8–15" long but no more than 2" in diameter, with dark purple or greenish skin, and is the type preferred by Asian cooks. The Italian-type eggplant is larger, usually ellipsoid to obovoid, 5–10" long and 3–5" in diameter, weighing as much as a pound and nearly always a deep, glossy purple-black. The Thai-type eggplant is globose, 1.5–2"

in diameter, greenish fading to white at the apex, with a network of darker green lines. Ornamental eggplants typically have small fruit (0.75–2" long) that is golden yellow, pure white, or purple.

Most plants produce a single bisexual flower at the base of each inflorescence, with the rest of the flowers on the inflorescence being functionally male, each with a reduced pistil. Male flowers may be lacking in some cultivars; in these, the inflorescence is reduced to a single, stalked, bisexual flower.

Eggplant is a warm-season crop that can be grown year-round in Hawai'i.⁴³⁷ Fertile, well-drained soils with a pH of 5.5–6.8 are required. Full sun and ample water are essential. Eggplants are usually grown from seed in flats or pots, then transplanted into the garden after six to eight weeks. Plants should be spaced 2–3' apart in rows 3–4' apart. Supplemental fertilizer applications (10-30-10 or 10-20-10) every two weeks after first fruit set and throughout bearing and harvest improve fruit size and plant vigor. The fruit takes 70–90 days to mature after transplanting and can be picked anytime after it is one-third mature. The fruit should be harvested before the seeds mature.

Eggplant should not be planted in areas where bacterial wilt is present in the soil, for there are no chemical controls or resistant varieties.¹¹⁴⁴ Pests of eggplant include aphids, red spider mites, and flea beetles, which can be controlled with chemical sprays. Chinese rose beetles attack the leaves at night but do not touch the fruit; for this reason, many gardeners make no effort to control these beetles unless they defoliate the plant. Sevin dust kills them but must be reapplied every time the foliage gets rinsed off by rainfall or watering. Bagging young fruit with paper or soft cloth bags protects it from fruit fly infestations.

***Solanum pseudocapsicum* Linnaeus, JERUSALEM-CHERRY, MADEIRA-CHERRY, WINTER-CHERRY**

Shrub to 6' tall, unarmed, glabrous or sparsely pubescent, hairs not star-shaped. Lvs simple; blades narrowly elliptic, to ca 4" long, base extending onto peti, margins entire or undulate. Infl 1- to several-flwd, pedicels ca 0.5" long, usu erect in frt. Flw cal ca 0.25" long, deeply 5-lobed; cor to 0.75" Ø, glabrous, white, deeply 5-lobed; stam \neq equal, anth <0.25" long, not tapered, opening by terminal pores that become slits. Frt erect, globose, 0.25–0.75" Ø, orange-red. Seeds yellowish. (see p. 537)

Jerusalem-cherry is originally from South America but has been grown on Madeira at least since 1650, accounting for one of its common names.³⁰⁸ It is often grown in containers for indoor use during the winter, when its shiny, scarlet red fruit and deep green foliage brighten a home or office. Jerusalem-cherry has also become a widespread tropical weed; in Hawai'i it has been naturalized since the late 1800s⁶³⁵ and is present on several of the islands.¹⁵³² All parts of the plant and the unripe fruit are considered toxic.^{57,578}

In Hawai'i, *S. pseudocapsicum* is sold as a container plant for indoor or patio use. It is hardy and easy to care for; its requirements are similar to those of chilis (*Capsicum*).

***Solanum seforthianum* H. C. Andrews, BRAZILIAN NIGHT-SHADE, STAR POTATO VINE**

Sprawling shrub or climber, unarmed, glabrous or sparsely pubescent with simple hairs. Lf simple or compound; peti 1–2" long; blades entire to pinnately 3–10-lobed. Infl usu panicle-like, many-flwd. Flw cal <0.25" long, entire or shallowly 5-lobed; cor 1–2" Ø, deeply 5-lobed, purple, pinkish, blue, or white; stam subequal, anth stout, opening by terminal pores that may become slits. Frt globose, 0.25–0.75" Ø, bright red, glabrous. Seeds reddish brown, hairy. (see p. 537)

This species is native to the West Indies but is frequently cultivated as an ornamental and may become naturalized in tropi-

cal climates, as it has in southern Florida and Hawai'i.¹⁵³² Lord Seaforth originally sent the material described as the type to Britain from the Caribbean island of Barbados. The berries are reputed to be poisonous.⁴²⁴

Solanum seaforthianum is grown as a climber on fences and trellises or included in a hedge or among shrubs. Plants grow well in full or partial sun on any reasonably fertile, well-drained soil with ample moisture. The individual flowers are not particularly showy but are attractive in groups. This little climber adds a quiet beauty to an old-fashioned chop suey garden. It is easily propagated by seeds or stem cuttings.

Solanum tuberosum Linnaeus, IRISH POTATO, WHITE POTATO; C: SUF JAI; H: 'UALA KAHIKI; K: JAGAIMO

Sprawling herb, usu <3' tall, unarmed, ±pubescent, hairs simple, often glandular; tubers present. Lvs pinnately compound, usu >4" long; major lfts 5–9, reduced lfts often present along rachis. Infl usu branched, pedicels jointed above middle. Flw cal to 0.5" long, 5-parted; cor wheel-shaped, shallowly 5-lobed, 1–1.5" Ø, white, pink, or pale purple; fil glabrous, anth ca 0.25" long, apex slightly tapered. Frt globose, 0.5–0.75" Ø, greenish.

Wild relatives of potato are native to temperate regions of the Americas, particularly the high Andes. Potato is a tetraploid (having twice the normal number of chromosomes) and may have evolved in cultivation in Europe from tetraploid species of the Andigena Group of *Solanum* that had been introduced from South America.¹⁵³² Potato reached Hawai'i soon after the arrival of Europeans and was planted by Don Francisco de Paula Marin in 1813.¹⁰¹⁰ All green parts of the plant, including tubers exposed to light, contain poisonous alkaloids. Fruit may occasionally be produced on cultivated plants, but it should not be eaten, because it also contains alkaloids.

Potato is one of the world's most economically important plant species. It is often grown in home gardens for its edible, starchy tubers. It has been suggested as a new crop for former sugar lands in leeward O'ahu, with the thought that an industry manufacturing potato chips and other processed foods might be developed here if a source of local potatoes were available to support it. Temperate-climate potato cultivars have not performed well in Hawai'i. Those recommended for all elevations include red-skinned cultivars such as 'Bliss Triumph', 'Kennebec', and 'Red Pontiac'; selections recommended for elevations above 2,500' are 'Pele' and 'Waimea', both developed for Hawai'i by the Hawaii Agricultural Experiment Station and quite tolerant to late blight, and the red-skinned cultivar 'Red La Soda'.¹³¹⁴

Potato is a cool-season crop. In Hawai'i it may be grown year-round above 2,500', but at lower elevations the best growing period is from October through March, when night temperatures are 60–70°F.¹³¹⁴ Well-drained, loose soil with a pH between 4.8 and 5.5 is most desirable. Full sun and ample, properly timed moisture are essential for good tuber production. If root-knot nematodes are present in the soil, a preplanting treatment with a nematicide is necessary. Potatoes are attacked by various insect pests and fungal diseases (such as late blight), which can be controlled with chemical agents. Potatoes are usually propagated by planting pieces of tubers (called seed potatoes) containing axillary buds, or "eyes." Purchasing certified seed potatoes is highly recommended over saving potatoes from year to year or utilizing potatoes from the grocery store. Pieces should be planted 2–3" deep in well-tilled soil in rows spaced 3' apart and 9–14" apart within the row. Fertilizer should be applied before planting and again four weeks later; use 10-30-10 or 10-20-10 at a rate of 2 pounds per 100 square feet. Harvest ranges from 90 to 140 days after planting, depending on the season, location, and cultivar. Plants yellow and die back when the tubers reach harvestable

stage. The tubers are then dug up and cured in a high-humidity area at room temperature for one or two weeks.

Other *Solanum*

Solanum americanum P. Miller [Syn.: *S. nodiflorum* N. Jacquin; Misapplied: *S. nigrum*], BLACK OR GLOSSY NIGHTSHADE, in Chinese LONG KUI, in Hawaiian PŌPOLO, in Japanese INUHOZUKI, is an unarmed herb or small shrub with simple leaves, small (ca 0.2" in diameter) purplish or whitish flowers, and shiny black berries borne on extra-axillary, umbel-like inflorescences. It is probably native to the New World but is now a cosmopolitan weed. There are considerable taxonomic and nomenclatural problems associated with *S. americanum* and its relatives brought on by a combination of factors including great morphological variability, polyploidy, and interspecific hybridization. Some botanists regard *S. americanum* and *S. nodiflorum* as distinct species;¹⁰⁰⁰ others, followed here, consider them to be a single species.^{379,1424} In Hawai'i, pōpolo is naturalized on all the main islands and is used medicinally for digestive problems and sore throat.¹⁵³² The young shoots are cooked as a vegetable in New Guinea and the Pacific Islands,¹⁵³² and the ripe berries are said to be edible. It has also been suggested, however, that the unripe fruit and green parts of the plant are poisonous.¹⁰⁰⁰

Fruit of **Solanum muricatum** W. Aiton, PEPINO DULCE, may be encountered in the specialty produce section of many North American grocery stores. It is often more than 4" long and 3" in diameter, egg-shaped (often with a pointed apex), and light yellow, green, or white with purplish stripes or mottling. The fruit is usually eaten raw, and the juicy flesh has a melon flavor. Pepinos are native to South America but are now grown commercially in Chile, New Zealand, and on a small scale in California and Hawai'i.¹⁰¹⁴ The plant is an unarmed, sprawling herb or subshrub with simple or compound leaves and whitish or purplish flowers.

Solanum quitoense Lamarck, LULO OR NARANJILLA, is another South American fruit that appears in Hawaiian grocery stores. The fruit is round, about 1–3" in diameter, yellow or orange on the outside, with a green pulp. It is not eaten raw but is used to make a delicious juice drink. The plant is an upright herb or shrub with large, coarsely toothed leaves, often with a purplish cast from the abundance of purple, star-shaped hairs, and whitish flowers borne in short, extra-axillary clusters. Naranjilla may be suitable for cultivation in cool, moist areas of Hawai'i, but it is susceptible to attack by root-knot nematodes and other pests and has exacting climatic and cultural requirements.¹⁰⁰⁴

Solanum torvum Swartz, known as PEA AUBERGINE, in Thai MA KHUEA PHUANG, is originally from the West Indies but is now established worldwide as a weed. It is listed by the U.S. Department of Agriculture as a noxious weed seed and is prohibited from sale or interstate shipment. This is a spiny treelet or shrub up to 15' tall, abundantly pubescent with star-shaped hairs, bearing branched, many-flowered inflorescences with glandular hairs on the peduncle and pedicels; the flowers are white and 1" in diameter. The greenish or yellowish fruit, 0.5–1" in diameter, is eaten in salads, curries, and sauces in Southeast Asia. The roots and fruit are also used medicinally in India, Malaysia, and the Philippines.¹¹³³ *Solanum torvum* grows in sunny, dry, hot environments and needs no special care to thrive under these conditions (see p. 537).

Solanum wendlandii J. D. Hooker, POTATO VINE, apparently native to Costa Rica, is another ornamental climber with purple flowers. It differs from *S. seaforthianum* in that it usually has recurved prickles on the stems and leaves. The corollas are shallowly lobed and the anthers narrow and usually more than 0.25" long. Plants in cultivation in Australia are reported to bear

only male flowers and thus must be propagated by cuttings.¹⁴²⁴ Potato vine is cultivated like *S. seafortianum*.

Solanum wrightii Benth [Misapplied: *S. grandiflorum*, *S. macranthum*], POTATO TREE, is grown as an ornamental for its large, showy flowers that fade from blue or purple to white as they age. It is a large shrub or small tree up to about 15' tall, commonly prickly, with large, petiolate leaves that are coarsely toothed or lobed on the margins. The upper leaf surfaces are pubescent with usually simple hairs, and the lower surface as well as the stems, petioles, inflorescence axes, and flowers are densely pubescent with star-shaped hairs. The corolla can reach 2.5" in diameter, and the berries reach about 2" in diameter. Because many of the flowers are functionally male (the pistil is reduced and nonfunctional), fewer fruits are produced than flowers. This species is native to South America. It has frequently been confused with *S. grandiflorum* Ruiz & Pavón and *S. macranthum* Dunal (see p. 537).

STREPTOSOLEN Miers (Gk. *streptos*, twisted + *solen*, pipe, referring to the twisted corolla tube)

Spineless shrubs to 6' tall; hairs simple. Lvs alternate, simple, petiolate; blades elliptic, 1–2" long, base tapered, margin entire, veins impressed on upper side, prominent below. Infl clustered, terminal; bracts leaflike. Flws bilaterally symmetrical; cal tubular, unequally 5-lobed; cor salver-shaped, yellow-orange to orange-red, tube ±twisted, ca 1" long, limb ca 0.75" Ø, 5-lobed; stam 4, upper 2 attached at cor mouth, lower 2 attached near cor base; ovary 2-celled. Frt a dry, 4-valved capsule, partly enclosed in persistent cal. Seeds <0.1" long.

There is a single species in the genus *Streptosolen*, native to the Andes.

Streptosolen jamesonii (Benth) Miers, MARMALADE BUSH
The single species has the characters of the genus.

Streptosolen is closely related to the genus *Browallia* but can be distinguished from the latter by its shrubby habit and orange-yellow, somewhat twisted corollas. In Hawai'i, cultivated specimens have been seen from the four largest islands at elevations of 1,500–4,000'. Although widely planted in tropical and subtropical regions of the world as an ornamental, it had not been reported to spread from cultivation until it was recently found naturalized on Kaua'i.⁸⁷⁰

In gardens, marmalade bush thrives in sunny, drier locations with cooler temperatures. Any well-drained, reasonably fertile soil is adequate. While the plant is actively growing more water is appreciated, but as growth tapers off drier conditions induce a heavier bloom.⁴⁰⁰ Once flowering is completed, the plant should be pruned for shaping and to remove twigs from the previous year's growth; this is a good time to fertilize as well. Marmalade bush is usually propagated by cuttings.

Other Solanaceae

Lycianthes (Dunal) Hassler contains perhaps 200 species native to tropical America and Asia. Some botanists include *Lycianthes* in *Solanum*, which it resembles in its 5 anthers that open by apical pores. *Lycianthes* can be distinguished from *Solanum* by its truncate calyx with 5 or 10 veins or teeth arising below the margin, and its solitary or clustered flowers arising in a leaf axil or branch fork. The only species grown in Hawai'i is **Lycianthes rantonnei** (Carrière) Bitter [Syn.: *Solanum rantonnei* Carrière, *S. rantonnetii* Lescuyer], BLUE POTATO BUSH, a South American native. This is a nearly glabrous shrub with entire to sinuate-margined leaves, dark blue or purple flowers with yellow centers, and red, fleshy fruit. It is grown as an ornamental for its showy flowers. All parts of the plant are poisonous because of their solanine alkaloid content.⁵⁷⁸

Lycium Linnaeus is a genus of about 100 species native to temperate regions of the Old and New World. Members are usually glabrous, spiny shrubs with clustered leaves; tubular, funnel-shaped, or bell-shaped corollas; usually 5 stamens with lengthwise-dehiscent anthers; and berry fruit. The species most commonly cultivated in Hawai'i is **Lycium chinense** P. Miller, known as CHINESE BOXTHORN or CHINESE MATRIMONY VINE, in Chinese GAU GEI CHOI or KOU-CHI, in Japanese KUKO. A native of eastern Asia, it is grown as an ornamental hedge for its purplish flowers and red to orange berries. Chinese matrimony vine thrives in many types of soils and is propagated by cuttings, layers, or seeds. The plants are difficult to eradicate once established, often sprouting by suckers. The branches are sold in Oriental markets for their leaves, which are used as a flavoring in soups and to make a medicinal tea.^{222,304} Several plant parts are used medicinally in China, Indonesia, and Malaysia.^{1133,1645}

Nicotiana Linnaeus is a genus of 60–70 species native to North and South America, Australia, the South Pacific, and southwestern Africa. These are soft-wooded shrubs or annual herbs, often densely glandular-pubescent, with flowers subtended by a single bract, calyx lobes fused for about half their length, funnel- or salver-shaped corollas, and 5 stamens. The fruits are dry capsules opening by 4 valves. The flowers are sometimes used locally for lei making.⁹⁴³ The nicotine contained in all parts of these plants makes them toxic.^{57,578} Several *Nicotiana* species are grown as ornamentals; two may be encountered in Hawai'i's gardens from time to time. **Nicotiana glauca** R. C. Graham, TREE TOBACCO or WILD TOBACCO, MĀKĀHALA or PAKA in Hawaiian, is rarely planted as an ornamental and can escape from cultivation. It can be distinguished from *N. tabacum* by its shrubby habit, yellowish green, narrowly tubular (rather than funnel-shaped) corollas, and glabrous stems and leaves. It is native to Argentina. The most economically important species in the genus is **Nicotiana tabacum** Linnaeus, TOBACCO, in Hawaiian PAKA, the major commercial source of tobacco. It is sometimes encountered in Hawai'i persisting in old gardens and fields where the plants were formerly grown. It is also sparingly naturalized, usually in dry, disturbed sites, often in coastal areas.¹⁵³² The plants are large, usually sparsely branched herbs up to 10' tall with abundant glandular pubescence. The leaves are large (to 20" long), narrowed at the base into a winged petiole and expanded at the junction with the stem into clasping lobes. The large, branched inflorescences bear 5-lobed, funnel-shaped, pinkish flowers. Tobacco was cultivated by indigenous peoples of the New World in pre-Columbian times as a ritual drug plant, and its use spread throughout the Americas. Tobacco was grown in Hawai'i by 1813 (or earlier), when Don Francisco de Paula Marin's diary records that he planted it in his garden.¹⁰¹⁰ *Nicotiana tabacum* is a tetraploid and is known only from cultivation. It is thought to have originated from hybridization between the diploids *N. otophora* Grisebach or *N. tomentosiformis* Goodspeed and *N. sylvestris* Spegazzini & Comes in South America^{520,1332} and is now commercially grown throughout the world in temperate and subtropical climates.

Nierembergia Ruiz & Pavón is a genus of about 30 species native to South America, with one disjunct species in Mexico. These are perennial herbs with white or purplish, funnel-shaped corollas composed of a slender tube surmounted by a broadly expanded limb, and 5 stamens tightly appressed to the stigma and style. The fruits are small, dry capsules surrounded by a persistent calyx. **Nierembergia hippomanica** Miers, known as CUP FLOWER, is native to Argentina and sold in Hawai'i and on the mainland as an ornamental bedding plant; the flowers are up to 1" in diameter. It is grown as a winter bedding plant, much like petunias, and is usually purchased from nurseries or can be propagated from seed. It is reported to be toxic to livestock.^{424,971,1423}