



Non-Invasive Fruit Trees for Gardens in Hawai'i

Patti Clifford¹ and Kent Kobayashi²

¹Hawai'i Invasive Species Council, ²CTAHR Department of Tropical Plant and Soil Sciences

How can fruit trees help protect the environment here in Hawai'i? And why should we use the Hawaii-Pacific Weed Risk Assessment (H.P.W.R.A.) system to screen the fruit tree species before we plant them? By growing fruit trees in our gardens, schoolyards, and community areas we contribute to the health of the soil, reduce the CO₂ level in the atmosphere, provide locally grown, nutritious fresh fruit, and support sustainability in our communities. Planting an edible landscape brings our children closer to nature and helps them to understand how their food grows. The H.P.W.R.A. system allows us to assess the potential a plant species has to escape our gardens or community areas and become invasive in our agricultural or native environments.

Hawaii-Pacific Weed Risk Assessment

The H.P.W.R.A. is a system that was developed by scientists who were concerned about the number of introduced plant species that were becoming invasive in our agricultural and native environments. Invasive species are plants (or animals) from other parts of the world that can harm the economy, the environment, and even human health. The H.P.W.R.A. system uses a series of 49 questions based on a plant species' biology, ecology, geographic origin, and pest status elsewhere to predict whether the species has the potential to be invasive in Hawai'i. Based on the score the species is rated as low risk, "evaluate" (needs more information), or high risk for invasiveness. High-risk species are more likely to cause economic or environmental harm to Hawai'i. This system is not legally binding, but it allows gardeners, landscapers, and possibly farmers to make informed decisions on the plant species chosen for planting. More information about the H.P.W.R.A. is available at www.hear.org/wra, along with a list of species that have already been screened. If a species you want

to plant is not on the list, you can request an assessment from the weed risk specialists at hpwra@yahoo.com.

Characteristics of invasive plant species

Many of the attributes that we appreciate in our garden plants have the same qualities that contribute to a plant's ability to invade natural and agricultural ecosystems. Some of these characteristics include:

- rapid growth (allows plants to take advantage of uninhabited gaps in the landscape)
- early maturity (allows plants to produce seed at a young age)
- high production of seeds (large numbers of offspring that can colonize gaps in the landscape)
- tolerance of shade (ability to spread into the understory of native forests)
- ability to grow on many different types of soils
- persistent seed bank (seeds remain viable over 1 year in the soil)
- effective seed dispersal mechanisms (birds, animals, wind)
- vegetative reproduction (can fill in gaps without producing seed)

Characteristics that lower a plant species' risk for invasiveness

- not self-fertilizing (needs more than one plant to reproduce)
- few dispersal mechanisms (limits the distance a seed travels from parent plant)
- limited seed production: <1000 seeds/m² (few offspring)
- no persistent seed bank (species needs to produce seed each year)
- not shade tolerant (requires sunlight to germinate and grow)

- requires human-assisted pollination
- doesn't spread vegetatively (needs seeds to reproduce)

Fortunately, the H.P.W.R.A. can evaluate these and other plant traits to predict which trees are likely to become invasive. This publication is designed to encourage gardeners to choose low-risk plants and thus to avoid planting high-risk invasive plants.

How to choose a fruit tree that fits your location and is low risk

It is often difficult to know where to plant a particular tree. Each living being has its own requirements to grow and thrive. Researching a plant's needs is always a good way to begin. The College of Tropical Agriculture and Human Resources (CTAHR, www.ctahr.hawaii.edu) has many resources that can assist a gardener to choose the right tree for their garden. Here are some basic guidelines to get you started.

Grow what your family eats. Make a list of the fruits that your family enjoys and that you can share with friends. Although harvesting fruit is time-consuming and seasonal, planting fruits that children can harvest creates quality time and enjoyable harvests in any season. There is nothing sweeter than watching children marvel at the bountifulness of nature as they pick fruit that they have nurtured in their garden.

Trees vary in their environmental requirements, and their yield and fruit quality depend on fulfilling these needs. Try to match a tree's size and nutritional needs to your garden space and time. Luckily, trees come in

many sizes and shapes, so there are a variety of choices of fruit trees that will fit a particular home garden site. You should also consider soil requirements, sunlight, and rainfall needs. Some trees species are slow growing or difficult to transplant (e.g., mangosteen). Choose your tree carefully based on its environmental needs and your expectations. Note that the elevation ranges given here are approximate; Hawai'i has many microclimates, and a tree's adaptability may vary.

How to use this information

The information in this publication was gathered to assist gardeners in Hawai'i to select non-invasive fruit trees to grow in their home gardens or community areas. Descriptions of seven fruit trees and a list of seven other fruit trees that have been evaluated as low risk by the H.P.W.R.A. are included. References to books and websites for more in-depth plant care guidelines are also included. URLs are hyperlinked in the pdf file of this publication, available at www.ctahr.hawaii.edu/oc/freepubs/pdf/F_N-17.pdf.

While not covered in this publication, the following trees have also received a low-risk rating by the H.P.W.R.A.: avocado (*Persea americana*), peanutbutter fruit (*Bunchosia argentea*), soursop (*Annona muricata*), lime (*Citrus aurantifolia*), mandarin (*Citrus reticulata*), banana (*Musa* species), papaya (*Carica papaya*), lychee (*Litchi chinensis*), longan (*Dimocarpus longan*), lemon (*Citrus limon*), mandarin orange (*Citrus reticulata*), sweet orange (*Citrus sinensis*), grapefruit (*Citrus x paradisi*), and calamondin (*Citrus x Citrofortunella mitis*).

Breadfruit

Scientific name *Artocarpus altilis*

Family Moraceae (the mulberry family)

Native distribution origin unknown, possibly from Indonesia, Papua New Guinea and the Pacific Islands

Plant description evergreen tree in wet humid regions; deciduous under drought or dry conditions

Height up to 100 ft

Growth rate fast growing

Preferred conditions

Soil thrives on a range of soils, sands, sandy loams, loams, sandy clay loams, needs drainage; pH 6.1–7.4

Light full sun

Water annually distributed rainfall of 60–120 inches

Elevation sea level to 5000 ft

Fruit description round, oval, or oblong; 3½–8 inches diameter to about 12 inches long; flesh is creamy white or pale yellow with a slightly aromatic flavor

Harvest trees begin bearing in 3–5 years

Yield a tree produces up to 600 fruits a year; average yield is 150–200 fruits

Nutritional value high in carbohydrates; good source of minerals and vitamins

Low-risk characteristics

not self-fertilizing

few dispersal mechanisms

limited seed production

no persistent seed bank



Cherimoya

Scientific name *Annona cherimola*

Family Annonaceae (the custard-apple family)

Common names cherimoya, kelemoio

Native distribution Peru and Ecuador

Plant description a low-branched, shrubby or spreading tree that is briefly deciduous in the spring

Height up to 24 ft

Growth rate fast

Preferred conditions

Soil tolerates a wide range of soil types from sandy to clay loams; pH 6.5–7.6

Light full sun

Water mean annual rainfall 50 inches

Elevation 800–5000 ft

Fruit description a compound fruit, conical or heart shaped, 4–8 inches long and up to 4 inches in diameter; the skin is pale-green to creamy yellow; the flesh is white and juicy with a lightly acidic flavor

Harvest trees begin bearing fruit when 3½–5 years old

Yield a tree produces up to 300 fruits a year

Nutritional value high in vitamin C; moderate source of potassium

Low-risk characteristics

few dispersal mechanisms

low seed production



Kumquat

Scientific name *Fortunella crassifolia*

Family Rutaceae (the citrus family)

Common name Meiwa kumquat

Native distribution China

Plant description an evergreen shrub or small tree

Height 8–15 ft tall

Growth rate slow

Preferred conditions

Soil wide range of soil types: sand, sandy loam, sandy clay loam, clay, clay loam, and sandy clay; needs good drainage; pH 5–8

Light full sun

Water mean annual rainfall 35–120 in

Elevation sea level to 2450 ft

Fruit description oblong to round, 1¾ inches long; the peel is orange-yellow, sweet, tender, and edible; the flesh is sour

Harvest grafted trees begin bearing fruit in 1–2 years

Yield 80–100 fruits per tree per year

Nutritional value good source of vitamin C

Low-risk characteristics

not a weed elsewhere

doesn't spread vegetatively

few dispersal mechanisms

limited seed production



Frankiesnursery.com



Ken Love

Macadamia

Scientific name *Macadamia integrifolia*

Family Proteaceae (the protea family)

Other common names macadamia, macadamier, smooth-shell, Queensland-nut

Native distribution Australia: New South Wales, Queensland

Plant description an evergreen tree

Height up to 62 ft

Growth rate slow

Preferred conditions

Soil 'a'ā lava or other deep, well-drained soil; pH 5.1–6.5

Light full sun

Water annual rainfall 60–80 inches

Elevation sea level to 2500 feet

Fruit description a slightly spindle-shaped fruit with a fleshy green husk; 1–1½ inches in diameter; white nut with a rich, slightly sweet flavor

Harvest trees begin bearing fruit at 3–6 years

Yield 100 lb per year

Nutritional value a good source of manganese and a moderate source of thiamin

Low-risk characteristics

not a weed elsewhere

few dispersal mechanisms

no persistent seed bank



Mangosteen

Scientific name *Garcinia mangostana*

Family Clusiaceae (the clusia family)

Other common names mangostan, king's fruit, queen's fruit

Native distribution thought to be native to Malaysia

Plant description a small, pyramid-shaped evergreen tree

Height up to 100 ft

Growth rate slow

Preferred conditions

Soil deep, rich organic, especially sandy loam or laterite (tropical soils rich in iron and aluminum)

Light seedlings need high shade, young trees need partial shade, mature trees can handle full sun

Water mean annual rainfall 60–200 inches

Elevation sea level to less than 1000 ft (in Hawai'i)

Fruit description the fruit is round, dark purple to red-purple and smooth externally; 1½–3 inches in diameter; the flesh is white with a slightly sweet to sour flavor

Harvest 10⁺-year-old trees can produce fruit (in Hawai'i)

Yield for 10–15-year-old trees it can vary from 90 to 150 lb of fruit per year

Nutritional value good source of carbohydrates and vitamin C

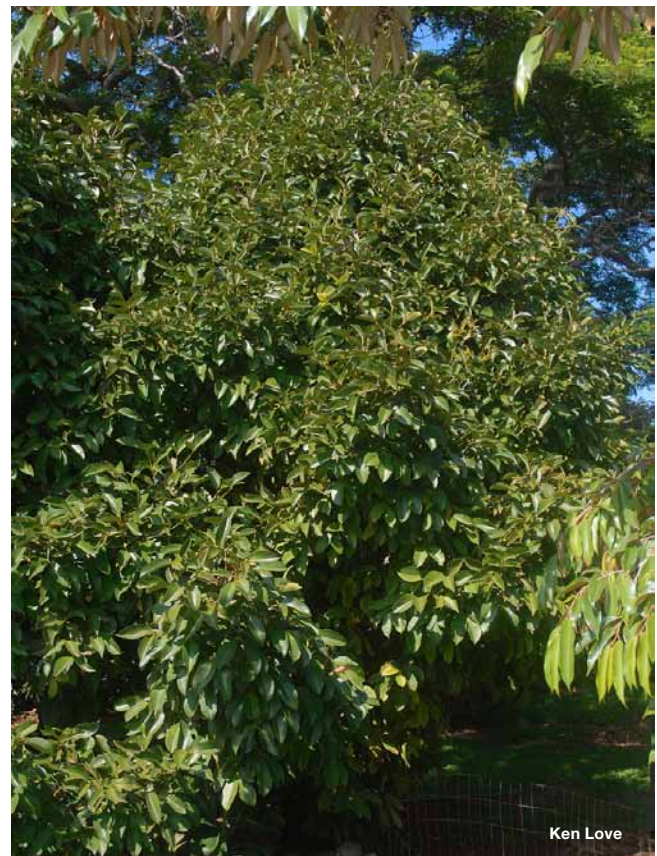
Low-risk characteristics

not a weed elsewhere

doesn't spread vegetatively

no persistent seed bank

few dispersal mechanisms



Pummelo

Scientific name *Citrus maxima*

Family Rutaceae (the citrus family)

Other common names shaddock, jabon

Native distribution Southeast Asia, Malaysia

Plant description a small bushy tree with a crooked trunk and irregular branches

Height up to 30 ft

Growth rate slow

Preferred conditions

Soil silty sand, clay loam

Light full sun to partial shade

Water mean annual rainfall of 60 inches

Elevation sea level to 1300 ft

Fruit description round, varying in size from 5 to 10 inches in diameter; skin pale-green, greenish-yellow, or yellowish; flesh transparent, whitish to pink or rose red, mildly acidic to mildly sweet

Harvest trees begin bearing fruit after 2–8 years; up to four harvests in one year.

Yield a tree produces 70–100 fruits per year

Nutritional value high in ascorbic acid and provitamin A

Low-risk characteristics

few dispersal mechanisms

low seed production

no persistent seed bank



Starfruit

Scientific name *Averrhoa carambola*

Family Oxalidaceae (the wood-sorrel family)

Other common name carambola

Native distribution the center of origin is unclear, possibly Indochina, Malaysia, and Indonesia

Plant description a small deciduous tree with a symmetrical, rounded top

Height 26–30 ft

Growth rate slow

Preferred conditions

Soil almost any soil type: sand to heavy clay loam or rocky calcareous soil; pH 5.5–6.5

Light full sun

Water annual rainfall of 60–120 inches

Elevation sea level to 1650 ft

Fruit description large berry 2–5 inches long and 1–2 inches in diameter; the flesh is yellowish orange with a very sour to mildly sweet flavor

Harvest grafted trees bear fruit within 9 months of planting with good yields after 2–3 years

Yield 220–550 lb per tree per year, with two to three crops per year

Nutritional value good source of vitamin K and vitamin A and a moderate source of vitamin C

Low-risk characteristics

not a weed elsewhere

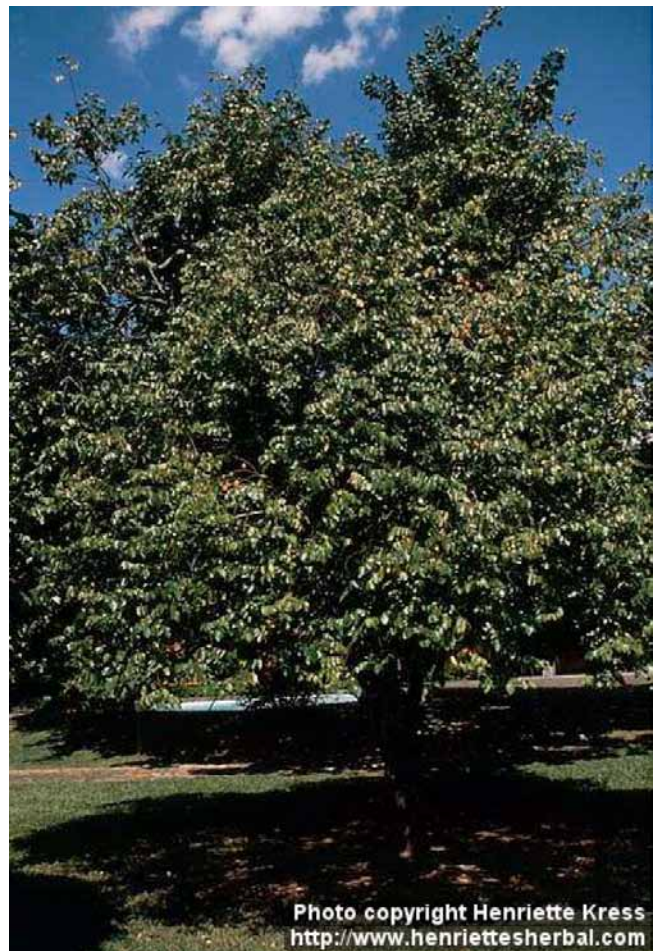
not self-fertilizing

no vegetative reproduction

few dispersal mechanisms

limited seed production

no persistent seed bank



References and further reading

- Bose, T.K., and S.K. Mitra (eds.). 2001. Fruits tropical and subtropical vol. 1, 3rd edition. Partha Sankar Basu, Calcutta.
- Diczbalis, Y. 2009. Farm and forestry production and marketing profile for mangosteen (*Garcinia mangostana*). In: Elevitch, C.R. (ed). Specialty crops for Pacific Island agroforestry. Permanent Agriculture Resources, Holualoa, Hawai'i.
- Hamilton, R.A. 1987. Ten tropical fruits of potential value for crop diversification in Hawaii. www.ctahr.hawaii.edu/oc/freepubs/pdf/RES-085.pdf.
- Miller, C.D., Bazore, K. and M. Bartow. 1965. Fruits of Hawaii. University of Hawai'i Press, Honolulu.
- Morton, J.F. 1987. Fruits of warm climates. Julia F. Morton, Miami.
- Nakasone, H.Y., and R.E. Paull. 1998. Tropical fruits. CABI Publishing, New York.
- Rauch, F.D. and P.R. Weissich. 2009. Small trees for the tropical landscape: a gardener's guide. University of Hawai'i Press, Honolulu.
- Staples, G. 2005. A tropical garden flora: Plants cultivated in the Hawaiian Islands and other tropical places. Bishop Museum Press, Honolulu.

Websites

- College of Tropical Agriculture and Human Resources**, University of Hawai'i at Mānoa. Downloadable pdf files of recent (from 1995) and some historical (from 1901) publications. Search for title words or author names at www.ctahr.hawaii.edu/freepubs; search entire text of available pdf files at <http://scholarspace.manoa.hawaii.edu/handle/10125/1877>.
- Hawaii Ecosystems at Risk** invasive species information for Hawai'i and the Pacific Islands; www.hear.org.
- Traditional Tree Initiative** this site has guides for growing traditional Pacific Island trees to promote sustainable agriculture and economic development while protecting ecosystem and cultural diversity; www.traditionaltree.org.
- Farmer's Bookshelf** an information system on tropical crops in Hawai'i; www.ctahr.hawaii.edu/fb.
- Agroforestry Net Inc.** resources about agroforestry and sustainable stewardship of land and water; www.agroforestry.net.
- World Agroforestry Centre** Agroforestry Database: a tree reference and selection guide; www.worldagroforestry.org/af/treedb.