



## *Thespesia populnea* (milo)

Malvaceae (mallow family)

*badirt* (Palau); *banalo* (Northern Marianas); *bang-beng* (Yap); *kilulo* (Guam); *mi'o* (Marquesas); *milo* (Hawai'i, Marshall Islands, Samoa, Tonga); *miro* (Pitcairn Island); *miro, 'amae* (Rarotonga, Society Islands); *mulomulo* (Fiji); *panu* (Kosrae); *polo* (Chuuk); *pone* (Pohnpei); *purau* (Tahiti); portia tree, seaside mahoe, Pacific rosewood, Indian tulip tree, cork tree, umbrella tree (English)

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Milo tree on a beach in Lahaina, Maui, Hawai'i.

### IN BRIEF

**Distribution** Coastal areas of the Indian and Pacific Oceans; throughout Oceania.

**Size** Small tree typically 6–10 m (20–33 ft) at maturity.

**Habitat** Tropical and warm subtropical, usually found at sea level to 150 m (500 ft).

**Vegetation** Associated with a wide range of coastal species.

**Soils** Thrives on sandy coastal soils as well as volcanic, limestone, and rocky soils.

**Growth rate** Moderate, 0.6–1 m/yr (2–3 ft/yr) for the first few years.

**Main agroforestry uses** Soil stabilization, windbreak.

**Main uses** Craftwood, ornamental.

**Yields** Heartwood in 30+ years.

**Intercropping** Compatible with many coastal species, although it requires full sun.

**Invasive potential** Has potential to become an invasive weed—should not be introduced into new areas.

## INTRODUCTION

Milo (*Thespesia populnea*) is one of the most important trees to Pacific Island peoples. The rich, dark wood is carved into beautiful bowls, tools, small canoes, and figures. Ropes are twisted from the bark. The trees provide protection against wind, salt spray, and the hot sun. The seeds, leaves, and bark provide medicine and food. In ancient times the trees were planted around temple sites. Today the tree is more rare than in the past because of overharvesting in some areas and increased urbanization in others. The tree is easy to grow and should be considered for reforestation and urban forestry projects in the Pacific where suitable sites are available.

Milo is a small evergreen tree averaging 6–10 m (20–33 ft) in height, with a short, often crooked stem and a broad, dense crown. It has glossy green, heart-shaped leaves and yellow hibiscus-type flowers. The tree grows well along warm coastal areas from the east coast of Africa and South and Southeast Asia to Melanesia, Micronesia, and Polynesia. It is currently naturalized in tropical climates throughout the world from the Caribbean to Africa.

The tree is valuable as a coastal windbreak because it is highly resistant to wind and salt spray and grows well in sandy, saline soils. It propagates easily and grows rapidly. It naturalizes easily and has become a weed in some areas, so it should not be planted in areas where it is not already present. The tree grows best under full sunlight and tolerates drought conditions. The heartwood is resistant to drywood termites. Milo has many uses including coastal protection, animal fodder, windbreaks, and living fences. The most common use in the Pacific today is probably as an ornamental tree, despite its valuable timber.

## DISTRIBUTION

### Native range

Milo is native to coastal areas of the Indian and Pacific Oceans, from East Africa and India to mainland Southeast Asia, Indonesia, and the Philippines. In the Pacific it grows from Papua New Guinea and the northern coast of Australia through the Solomons, Vanuatu, and Fiji. In Micronesia milo grows in Guam and the Mariana Islands, the Gilbert Islands (Kiribati), and in Palau, Yap, Chuuk, Pohnpei, Kosrae, and the Marshalls. In Polynesia milo is found in Tonga, Samoa, Niue, the Cook Islands, Tahiti, the Society Islands, the Tuamotos, and the Marquesas (Muel-ler-Dombois and Fosberg 1998).

### Current distribution

Milo has been planted throughout the tropics and is naturalized in tropical climates throughout the world from the Caribbean to Africa to the Pacific. The tree is believed to have been introduced to Hawai'i by early Polynesians, but it may be native to Hawai'i. It is documented on the Hawaiian islands of Ni'ihau, Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i (Wagner et al. 1999).

## BOTANICAL DESCRIPTION

### Preferred scientific name

*Thespesia populnea* (L.) Sol. ex Correa

### Family

Malvaceae (mallow family)

### Non-preferred scientific names

*Hibiscus populneus* L. (1753)

*Thespesia macrophylla* Blume (1825)

*Hibiscus populneoides* Roxb. (1832)

### Common names

*badriert* (Palau)

*banalo* (Northern Marianas)

*bang-beng* (Yap)

*kilulo* (Guam)

*mi'o* (Marquesas)

*milo* (Hawai'i, Marshall Islands, Samoa, Tonga)

*miro* (Pitcairn Island)

*miro, 'amae* (Rarotonga, Society Islands)

*mulomulo* (Fiji)

*panu* (Kosrae)

*polo* (Chuuk)

*pone* (Pohnpei)

*purau* (Tahiti)

*portia tree, seaside mahoe* (a name also applied to *Hibiscus tiliaceus*), Pacific rosewood, Indian tulip tree, cork tree, umbrella tree (English)

### Other common names

*alamo, alamo blanco, carana, clamour, duartiana, emajaguilla, biguillo, jaqueca, majaguilla, majagua de la Florida, palo de jaqueca* (Spanish)

*baru laut, salimuli, waru laut, waru lot* (Indonesian)

*baru, baru baru, baru laut, bebaru, buah keras laut* (Malay)

*bhendi, gajadanda, paras-pipal, parsipu, porush* (Hindi)

*feuilles d'Haiti, motel debou* (French)

large-leaved tulip tree (trade name)

*pho-thale, po kamat phrai* (Thai)



**Left: Newly opened flower. Right: Leaves and older flower.** PHOTOS: J. B. FRIDAY

### Size and form

Milo has a short, straight or crooked trunk and a dense crown with crowded lower horizontal branches. Height averages 6–10 m (20–33 ft) with a crown as wide as or wider than the tree is tall. Average size trees have bole diameters of 20–30 cm (8–12 in), but exceptional trees have reached 18 m (60 ft) in height with boles 60 cm (24 in) in diameter. The bark is grey and smooth to highly fissured and dark brown in larger trees.

### Flowers

Flowers are a typical hibiscus shape in appearance: bell-shaped, 4–7 cm (1.5–2.5 in) in length, with five overlapping, broad, rounded petals. Color is pale yellow with a maroon spot at the base of each petal and with star-shaped hairs on outer surface. Flower stalks are 1.3–5 cm (0.5–2 in). Flowers open and close on same day, and the yellow flowers turn dark red, purple, or pink as the day progresses.

### Leaves

The alternate leaves are glossy green above and paler green below. Leaf blades are heart-shaped, 10–20 cm (4–8 in) long, and 6–13 cm (2.5–5 in) broad. Leaf stalks are long, 5–10 cm (2–4 in). Leaves in the lower crown turn yellow before falling to the ground.

### Fruit

Milo fruits are brittle, dry, woody or papery seed capsules, rounded and flattened, containing five cells and several seeds. The brown or gray capsules, about 2.5–5 cm (1–2 in) in diameter and 2 cm (0.8 in) tall, grow on short stalks clustered at the ends of the branches. Mature fruits may usually be found on trees year-round.

### Seeds

The brown, hairy seeds are about 1 cm (0.4 in) long and 0.6 cm (0.2 in) broad. Seeds are blown short distances by wind but are more likely to be dispersed by water. Both the lightweight fruits and seeds can float from one island to another on ocean currents. There are between 3500 and 6700 seeds/kg (1600–3045 seeds/lb) (Parotta 1994).

### Similar or look-a-like species

There are 18 species of *Thebespesia* throughout the tropics. *Thebespesia populneoides* (Roxb.) Kostelecky, a closely related species native to the Indian Ocean, may be distinguished by its dehiscent fruit, long pedicels, and coppery or bronzed leaves (Fosberg and Sachet 1972). Milo is often confused with the related *Hibiscus tiliaceus* (hau or sea-side hibiscus). Milo may be distinguished from hau by its rounded and flattened dark brown seed capsules in upper crown. While both species have heart-shaped leaves, milo



Trunk of large tree showing common curved form. PHOTO: C. ELEVITCH

leaves are narrower than they are long, glossy, and smooth-edged, while hau leaves are often almost round and hairy on the underside, sometimes with wavy or toothed edges.

## ASSOCIATED PLANT SPECIES

Milo is a tree of coastal regions of the tropical Indian and Pacific Oceans and is associated with a wide range of coastal species.

### In native habitat

Milo occasionally is found in beach scrub forests along with small trees and shrubs such as hau (*Hibiscus tiliaceus*), naupaka (*Scaevola taccada*), beach heliotrope (*Tournefortia argentea*), pandanus (*Pandanus tectorius*),

and noni (*Morinda citrifolia*). Milo more commonly grows in coastal high forests along with kou (*Cordia subcordata*), kamani (*Calophyllum inophyllum*), *Pisonia grandis*, Indian almond (*Terminalia catappa*), ironwood (*Casuarina* spp.), and *Barringtonia asiatica*. Native herbaceous plants commonly include *Canavalia*, beach morning glory (*Ipomoea pes-caprae*), and beach pea (*Vigna marina*) (Mueller-Dombois and Fosberg 1998). Milo may also be found at the edges of mangrove forests. It does not grow naturally in upland high forests.

### As introduction to Pacific islands

In coastal areas milo may grow in mixed agroforests of breadfruit, coconut, pandanus, tamarind, noni, and mango. In Hawai'i, milo trees are frequently found growing alongside several introduced coastal tree species, including ironwood (*Casuarina equisetifolia*), Indian almond (*Terminalia catappa*), and beach heliotrope (*Tournefortia argentea*).

## ENVIRONMENTAL PREFERENCES AND TOLERANCES

### Habitat

Milo is a tree of tropical and warm subtropical climates. It is purely a coastal species and is not found any great distance inland.

### Elevation range

Sea level to 150 m (500 ft); in Hawai'i it grows as high as 275 m (900 ft), although it is probably planted at higher elevations.

### Mean annual rainfall

500–4000 mm (20–160 in). In very dry areas milo survives by tapping underground water.

### Rainfall pattern

Grows in climates with summer, winter, or uniform rainfall patterns.

### Dry season duration (consecutive months with <40 mm [1.6 in] rainfall)

Up to 8 months

**Mean annual temperature**

20–26°C (68–79°F)

**Mean maximum temperature of hottest month**

26–28°C (79–82°F)

**Mean minimum temperature of coldest month**

18–26°C (64–79°F)

**Minimum temperature tolerated**

2°C (36°F)

**Soils**

Milo thrives on sandy coastal soils, but also grows on volcanic soils, soils derived from limestone, and rocky headlands. It does not do well on upland, acidic clays.

**Soil texture**

It tolerates light to heavy soils (sands, sandy loams, loams, sandy clay loams, clays, clay loams, and sandy clays).

**Soil drainage**

The tree grows in freely draining soils and in coastal areas with occasional tidal inundation.

**Soil acidity**

Milo prefers neutral soils with pH 6.0–7.4.

**Special soil tolerances**

It tolerates saline soils.

**Tolerances****Drought**

Once established, milo has a deep taproot and can tolerate long periods of drought.

**Full sun**

Milo prefers full sun.

**Shade**

Seeds germinate in light shade but plants will not grow well.

**Frost**

Milo tolerates light frosts at the extremes of its range.

**Waterlogging**

Milo is occasionally found at the edges of mangrove



**Milo tolerates heavy salt spray and periodic inundation with brackish water.** PHOTO: C. ELEVITCH

swamps and at the high tide line and will tolerate occasional inundation.

### **Salt spray**

Milo is very tolerant of salt spray.

### **Wind**

It tolerates steady coastal winds, although isolated trees may show some leaf loss and flagging in windy locations.

### **Abilities**

#### **Regenerate rapidly**

Milo regenerates rapidly from seed and forms thickets.

#### **Self-prune**

Milo does not self-prune well, tending to develop crooked stems with stout, low branches that persist as part of the main structure of the tree.

#### **Coppice**

It regrows after pruning, although slowly.

#### **Other**

Milo is highly resistant to drywood termites.

## **GROWTH AND DEVELOPMENT**

In suitable locations milo establishes well and grows rapidly. Mature trees are large and usually gnarled, and spreading rather than tall and stately.

### **Growth rate**

Height growth is moderately fast, 0.6–1 m/yr (24–39 in/yr) for the first few years.

### **Flowering and fruiting**

Milo flowers last only a day. In cooler areas, flowering occurs from early spring to late summer, whereas flowering is year-round in warmer climates. Flowering may begin in trees as young as 1–2 years old.

### **Yields**

Milo has never been grown in a plantation system where yields of timber have been calculated. Trees may take 25–40 years to grow large enough to have enough heartwood for carving.

### **Rooting habit**

Milo's shallow roots tend to spread on the surface, espe-



**A thicket of milo naturally regenerating near a beach in Hilo, Hawai'i.** PHOTO: J. B. FRIDAY

cially in shallow, rocky, or occasionally flooded soils. In porous soils, milo will rapidly develop a long taproot to tap deep water sources.

### Reaction to competition

Milo is an aggressive competitor in the sun but will not grow well in the understory of other trees.

## PROPAGATION

Milo is generally propagated by seed, although it can also be propagated by stem and root cuttings and by air-layering. Seeds are usually plentiful and initial growth is fast, making milo a relatively easy tree to grow. Containers need to be deep enough to contain the vigorous taproot without allowing it to spiral.

### Seed collection

Seeds may be collected at almost any time of year. The capsules stay on the trees for some time after ripening and may be hand-picked or knocked off trees with sticks or pruning hooks. Freshly fallen capsules may be picked up from the ground under trees. Only mature seed from dried capsules should be collected.

### Seed characteristics

If capsules are not completely dry they may be sun-dried for a day or two. The brittle seed capsules may be crushed by hand and the seeds extracted. Larger batches may be crushed inside burlap bags and the seeds cleaned from the chaff by winnowing or blowing. Discard seeds with insect holes or that are soft when squeezed.

### Seed storage

Seeds retain viability when dried and stored; such storage behavior is also known as “orthodox.” There are 3500–6700 air-dried seeds per kilogram (1600–3000 seeds/lb). Seeds may be stored at room temperature in sealed containers for short periods of time. Refrigeration may prolong seed life, but as fresh seed is usually available, long-term seed storage is usually not necessary.

### Pre-planting treatments

No seed pretreatment is required, but germination can be hastened by abrading the seed coat with sandpaper or nicking it with a sharp knife or nail clippers and soaking the seeds overnight in cool water. Care must be taken not to injure the seed embryo.



Green and dried seed capsules still on branch. PHOTO: J. B. FRIDAY



Dried seed capsules and seed. PHOTO: J. B. FRIDAY

### Growing area

Milo should be grown in partial to full sunlight. Some cover is useful to protect the seedlings from hard rains right after germination.

### Germination

Germination begins in 8 days and may extend to 10 weeks. Germination of fresh seed should be 65–80%. Seeds may be pre-germinated in moist towels and then transplanted into growing containers.



**Left: Pregerminated seeds sprouting in growing containers. Right: Kim Wilkinson shows seedlings ready for outplanting.** PHOTOS: C. ELEVITCH

## Media

The potting medium must be well drained. A soilless potting mix of peat moss, cinder, perlite, or vermiculite is recommended. The medium should be amended with slow-release fertilizers or compost. Milo develops a long taproot, so pots must be large enough so that the roots do not circle the bottom of the container, at least 20 cm (8 in) deep. Root-training containers or copper-coated poly bags are preferred if available. Seeds should be planted about 5 mm (0.2 in) deep and covered with a thin layer of potting mixture. Containers can be topped with a thin layer of coarse sand to discourage weeds. Seedlings should be watered daily, although overwatering should be avoided. As seedlings develop they should be spaced wider to promote strong stem development, full leaf growth, and good air circulation.

## Time to outplanting

Trees are ready to be outplanted when they reach 15–25 cm (6–10 in) in height, in about 12–16 weeks. Seedlings should be hardened off with reduced watering and exposure to full sunlight for 4–6 weeks before being outplanted.

## Approximate size at time of outplanting

Seedlings ready for outplanting are approximately 40–50 cm (16–20 in) in height. Seedlings usually grow slowly for the first 6–10 weeks, then grow more rapidly.

## Guidelines for outplanting

Seedlings need to be protected from drying out on the way to the planting site, which means protecting them from sunlight, wind, and heat. It is better to keep seedlings in

their containers until planting. Refrigeration is not recommended. Weed control of planting sites is essential, and watering aids initial establishment.

## Other comments on propagation

Bare-root seedlings may also be used. Wildlings are frequent along coastal areas, and these may be transplanted if they can be uprooted with little damage to the roots. Stump plantings have also been used, where bareroot or wild seedlings are uprooted and cut back to 1 cm (0.4 in) above the root collar before transplanting. This method allows the roots to recover before new leaves develop. Milo may also be propagated using branch or shoot cuttings, although propagation from seeds is preferred. Shoots or branch cuttings of up to 2 m (6.6 ft) length and 10 cm (4 in) diameter have been used (Parotta 1994), although smaller cuttings are preferred and produce healthier trees.

## DISADVANTAGES

While the heartwood of milo is a prime carving wood, the trees usually are too small and crooked to produce much sawn lumber. Little is known about the growth rates and possible timber production from milo. Coastal areas in the Pacific where milo grows are being rapidly lost to urbanization, and the tree is becoming less common.

## Potential for invasiveness

Milo has the potential to become an invasive weed and should not be introduced into areas where it is not already present. The tree has naturalized in Florida and the Caribbean, where it was introduced as an ornamental. In Florida



it is considered a problem weed both in natural areas and in cultivated landscapes. The tree seeds prolifically, and seeds are easily dispersed by ocean currents. It grows in dense thickets that tend to exclude other plants but do not produce trees of a size that would make harvesting attractive. The tree has taken over beaches used by nesting sea turtles in the West Indies.

### Diseases and pests

Milo is susceptible to fungal leaf spot (*Lophodermium* sp.) in Hawai'i and several other fungi and bacteria throughout the world. The tree is also susceptible to a fungal root and stem rot caused by *Phellinus noxius*. The fungus appears as diseased patches and a thick brown sheath around infected roots (Hanum and van der Maesen 1997). In India the fungus *Fomes pachyphloeus* causes heart rot.

### Host to crop pests/pathogens

Milo is a host to several important pests of cotton, including the cotton stainer bug (*Dysdercus* sp.), the cotton boll weevil (*Anthonomus grandis*), *Pyroderces simplex*, and the Indian dusky cotton bug (*Oxycarenus laetus*). For this reason the tree has been eradicated from and outlawed in West Indian islands where cotton is an important crop.

### Other disadvantages or design considerations

Growth is modest or poor on many sites. Milo is not adapted to inland areas or upland acid clay soils. The species has failed to survive or grow well in plantation trials in Hawai'i on deep, acid soil at 380 m (1250 ft) elevation with 2000 mm (80 in) rainfall at 'Opa'e'ula, O'ahu; on deep, acid soil with 2000 mm (80 in) rainfall at 150 m (500 ft) elevation at Maunawili, O'ahu; or on thin, acid soil derived from organic matter over 'a'a lava rock at elevation 180 m (600 ft) and rainfall 4000 mm (160 in) at Wai'ikea, Hawai'i. All trials were fertilized and planted in single-species blocks.

Milo creates large amounts of litter both from fallen leaves and fallen seed capsules, which may detract from its use as an urban ornamental.

## AGROFORESTRY/ ENVIRONMENTAL PRACTICES

### Mulch/organic matter

Milo provides abundant leaf litter for use as mulch in sandy, coastal sites.

### Soil stabilization

Milo anchors sandy coastal soils and protects them from erosion. The tree is used to stabilize bunds for ponds for prawn production (Hanum and van der Maesen 1997)

### Homegardens

Since ancient times, milo has been planted around houses in the Pacific islands for shade and ornament.

### Living fences

Milo has been used as a living fence post.

### Windbreaks

Milo is an excellent windbreak in coastal areas due to its dense crown and tolerance of wind and salt spray.

### Animal fodder

Leaves have been used as animal fodder.

### Coastal protection

Milo tolerates droughty sandy soils, brackish water, water-logging, wind, and salt spray, and so is an excellent species for coastal protection.

### Ornamental

Milo provides dense shade and attractive leaves and flowers and so is a favored ornamental in tropical areas. It is a tough tree and can survive the poor drainage and hot, dry conditions common to urban areas.



Homegarden in Nukualofa, Tonga. PHOTO: C. ELEVITCH

## USES AND PRODUCTS

Milo continues to be an important shade and ornamental tree in the Pacific. The wood is prized by craftspeople and carvers.

### Leaf vegetable

The young leaves and green fruits are said to be edible as vegetables when cooked.

### Medicinal

Milo has been used many ways in traditional medicines in Polynesia and South Asia. In Fiji, a decoction of the leaves has been used in treating coughs and headaches. In Samoa, an infusion of the bark has been used to treat intestinal diseases. In Tonga, a drink made from the leaves and bark is used to treat fevers in teething children. It should be kept in mind that traditional cures are rooted in specific cultures and will likely not be effective when taken out of context. Various parts of the plants have high tannin contents and plant extracts have been shown to have anti-bacterial and anti-viral activity.

### Beautiful/fragrant flowers

The attractive yellow flowers add to milo's appeal as an ornamental tree.

### Craft wood/tools

Milo has beautiful wood that has been used since ancient times for bowls, utensils, jewelry, furniture, carved figurines, and other craft items. The ancient Hawaiians favored milo for calabashes and poi bowls, along with kou (*Cordia subcordata*) and kamani (*Calophyllum inophyllum*). Unlike koa (*Acacia koa*) wood, the wood of milo does not impart a flavor to food. The heartwood is reddish brown to dark brown or black with light brown to cream-colored sapwood. The wood texture is fine, with a streaked or wavy figure and straight or wavy grain. The interlocked grain may produce a ribbon figure when the wood is quartersawn. The specific gravity is moderate to high, 0.44 to 0.89 (27.5–55.4 lb/ft<sup>3</sup>) air-dried, averaging around 0.6 (37.4 lb/ft<sup>3</sup>). The wood only shrinks slightly in drying. It is easy to work, polishes well, and is very durable. The wood contains an oil that adds to its luster but may affect the drying of oil-based finishes.

### Canoe/boat/raft making

Large trees were made into small canoes in ancient times in Hawai'i, although koa (*Acacia koa*) was the preferred wood for canoe building (Abbott 1992). Milo's durable wood is also used for boat building in South Asia and elsewhere in the Pacific.



**Free-form vase turned and carved from milo wood by Ralph Michaelis, Hawai'i.** PHOTO: R. MICHAELIS

### Rope/cordage/string

The outer bark may be used for rope and the inner bark for finer cordage, although it is inferior to hau (*Hibiscus tiliaceus*) for this purpose. The bark is also used for caulking.

### Wrapping/parcelization

Milo leaves are used as food wrapping in West Africa.

### Tannin/dye

In old Hawai'i, a dye made from the seed capsules yielded a yellowish green color (Krauss 1993). The wood may also produce a yellow dye used to dye wool in East and South-east Asia, and the leaves are used to make a black dye for pandanus in Tuvalu (Clarke and Thaman 1993). The bark contains high levels of tannins and has been used for tanning leather.

### Oil/lubricant

Lamp oil may be made from the seeds.

### Ceremonial/religious

In the traditional religion of Tahiti the milo tree was associated with the god of prayer and chanting and was therefore planted around temples (Neal 1965). Branches were attached to canoe masts as a token of peace in Tahiti, and the leaves were used by priests in ceremonial offerings (Clarke and Thaman 1993).

## WOOD PROPERTIES

(contributed by C. Barton Potter)

The wood of the milo tree is stable and attractive and has been fashioned into a wide variety of functional and decorative items in whatever country it grows. It is known to be a premier carving wood because, although dense, the wood can be cut to fine detail. So well known is milo wood that when a milo tree is cut, the wood seldom goes to waste. Unfortunately, like the black walnut on the mainland U.S., unprotected mature milo trees have been known to be illegally harvested for their wood.

### Quality

Wood of young trees and young branches (under 20 years or so) tends to have a greater proportion of sapwood to heartwood. Wood from relatively younger trees and branches is less stable, less dense, less resistant to bugs, and, most would agree, less attractive than wood from mature trees. As the tree matures, the pale sapwood becomes clearly differentiated from the heartwood and accounts for an increasingly smaller proportion of the mass of the branch or bole. Wrist-sized branches in a mature tree may have a significant amount of heartwood, while thigh-sized branches in young trees may be devoid of heartwood. Thus, tree age is an asset that tends to improve the stability, durability, and character of milo.

### Pith defect

Like many trees, milo grows rapidly when young. The wood generated in this fast growing phase is less dense and enduring than the wood that is continually added to the outside of the tree as it grows older. The weaker heartwood near the center is more prone to rotting than the heartwood that is generated from approximately 15 years of age onwards. For this reason, older milo trees and branches often have a hollow center surrounded by fine, high-quality wood. This higher quality heartwood is very resistant to termites and fungal growth.

### Color

Heartwood in a freshly cut log is most often pale pink, occasionally with a black ring or two that offer a nice visual highlight. On rare occasions, the heartwood of the tree is dark reddish purple when fresh cut. As milo wood cures it takes on a dark color ranging from chocolate brown to black. Articles made from freshly cut wood eventually darken as the wood seasons.

### Photoreactivity

Although the heartwood is dark, exterior surfaces of furniture and artwork made of milo lighten with constant ex-

posure to the sun. While a coating of oil, shellac, lacquer or varnish will accentuate the color, milo is particularly photoreactive and has a tendency to bleach out much sooner than other woods when left in the sun. This bleaching is only as deep as the finish and the first layer of cells of the wood, but many woodworkers and their customers have been disappointed with the color change when an article was placed in a sunny location. Finishes applied to milo tend to prematurely yellow along with the wood if articles are placed in high sunlight areas. Addition of a UV blocking agent to the finish and keeping the finished piece away from direct sunlight will prolong the length of time that a milo piece will retain its dark color.

### Fragrance

Wood of the mature milo tree has a pleasing but fleeting spicy smell. That is, the fragrance mostly disappears or is not at all evident in most finished pieces.

### Allergenic properties

It is common for people working with milo wood over a period of years to develop progressive skin and mucous membrane sensitivity to the dust created in sanding the wood. Typical symptoms include runny nose, itchy eyes, shortness of breath, and skin irritation.

### Storage and seasoning

Milo is a close-grained hardwood and does not dry quickly. End-sealing of fresh cut logs with one of several commercial water-based paraffin products will greatly inhibit end-checking and maximize the usable wood from the logs. It is generally best to cut lumber, bowls, or craft items out of logs while the log is still green, then dry the wood.

The contrast between the light colored sapwood and the darker heartwood is a pleasing feature regarded by some as a signature of milo in finished woodwork, and it may be desirable to preserve this contrast as much as possible. If left to lie on the ground, the sapwood of milo can start to discolor within a few weeks. If logs cannot be worked soon after cutting, they are best stored off the ground, out of the sun, and with good air circulation to preserve the sapwood color.

### Gluing and finishing

Milo is known to experience glue joint failures and is thought to inhibit the setup of some finishes. Best gluing results are obtained on dry wood using urea formaldehyde glues and epoxies, whereas white glues and hide glues will not give reliable bonds.

## MILO LORE

The name *Thespesia* is derived from the Greek word *thespesios*, which means divine. Milo was named by Daniel Solander, a member of Captain Cook's expedition, who found it planted around temples in Tahiti.

A Hawaiian saying is

*He milo ka lā'au, milmilo ke aloha.*

Milo is the plant; love goes round and round.

(This was chanted by a kahuna, a traditional priest, in casting love spells.) (Pukui 1983)

A line from the *Kumulipo*, the Hawaiian creation chant, goes:

Born is the Laumilo eel living in the sea

Guarded by the Milo tree living on the land.

## URBAN AND COMMUNITY FORESTRY

Milo is a medium-sized coastal tree with a dense, round crown of glossy, dark green leaves and yellow hibiscus-like flowers. It is native to the South Pacific and the Indian Ocean and was brought to Hawai'i by the early Polynesian voyagers. Ancient Hawaiians prized the dark red heartwood for making calabashes, and it is still prized by bowl turners today. Leaves, flowers, and bark have been used medicinally in South Asia and the Pacific. Milo is seen as a sacred tree in some Pacific island cultures. A popular modern ornamental and urban forestry tree, milo tolerates salt and wind very well and may be planted right down to the waterside.

Milo is one of the "canoe plants" brought to Hawai'i by the first Polynesian voyagers and grown around temples and dwelling places. Growing milo in urban and community landscapes creates a link to past island traditions.

### Size in an urban environment

Open-grown trees in urban settings usually reach 10–12 m (33–40 ft) in height with a canopy spread as wide as the tree is tall. However, with its modest growth rate, it would take several decades to reach its maximum height. When the trees are grown in the open, the canopy spread can be greater than the height.

### Rate of growth in a landscape

Young milo trees in landscape settings grow about 0.5–1.5 m/yr (1.6–5 ft/yr) for the first few years in both height and canopy spread. At an age of 7–10 years, growth in height

slows considerably. Stem diameter growth ranges from 1 to 3 cm/yr (0.4–1.2 in/yr).

### Root system

In urban forestry settings, milo has a non-aggressive root system. When planted on shallow, rocky, or occasionally flooded soils, milo trees have shallow, spreading roots. While these help the trees to survive in harsh planting conditions, they may interfere with other landscaping.

### Products commonly used in a Pacific island household

Milo's dark red, glossy wood is prized for carving, fine woodworking, and bowl turning. In traditional Pacific island cultures, the leaves, flowers, and bark are used medicinally.

### Light requirements

Milo grows best in full sun and casts a dense shade.

### Water/soil requirements

Since milo is adapted to grow in coastal environments, it tolerates shallow, rocky, and sandy soils as well as soils that are occasionally flooded. The tree is often found growing right down to the shoreline. Unlike a mangrove, however, it will not grow in constantly standing water.

### Life span

Ancient trees up to 60 cm (2 ft) in diameter exist and must be many decades old.

### Varieties favored for use in homegardens or public areas

There are no selected varieties of milo.

### Seasonality of leaf flush, flowering, fruiting

Milo flowers year-round. Usually flowers and green and brown (ripe, dried) fruits can be seen on a single tree.

### Exceptional ornamental values

The showy yellow hibiscus-like flowers last only a day. The tree's main attraction is the heart-shaped, glossy, dark green foliage and dark brown, fissured bark.

### Use as living fence, hedge or visual/noise barrier

Milo makes a good windbreak and visual barrier, especially in coastal areas. The tree forms a dense canopy, even in areas prone to salt spray. Thickets of seedlings will spring up under mature trees, which may be desirable if a hedge



**Left: Trees seed prolifically and drop large numbers of the dry seed capsules. Streets and sidewalks under milo trees may need to be cleaned frequently. Right: When planted on rocky soils, milo trees have shallow, spreading roots.** PHOTOS: J. B. FRIDAY

is needed but may be a nuisance under ornamental trees. A dense milo hedge makes an excellent high-surf barrier between homes and the ocean.

### **Maintenance requirements**

Although small seedlings grown in dibble tubes are best for forestry or agroforestry plantings, relatively large milo trees grown in pots can be used in landscape settings if larger trees are desired right away. Trees up to 3.5 m (12 ft) have transplanted well from containers. Holes should be dug twice as wide as the root ball but no deeper. When planting larger seedlings grown in pots or plastic bags, it is important to loosen and straighten or cut any roots that have begun circling the bottom of the container. Use of specialized tree-growing pots will lessen the problem of pot-bound seedlings. Application of a complete fertilizer or compost can aid establishment and boost initial growth.

Milo tolerates heavy pruning, and trees will grow back

even if topped or pollarded. Topping weakens trees, however, and branches on topped trees will never be as strong as the original branches. It is better to plant the trees where they can grow to their full size and then prune for form. Pollarding is a specialized style of pruning. Rather than topping a tree by cutting off large branches, arborists establish a tree's size and framework early on by cutting back young growth. New growth is subsequently cut back to the same point and eventually large "pollard heads" of woundwood are established at the branch ends. Pollarded trees require more frequent attention than topped trees but are more attractive and healthier (Shigo 1989).

Milo tends to be multiple-stemmed, and if a shade or ornamental tree is desired, the tree needs to be pruned back to a single stem. Milo will usually not grow tall enough to yield lumber without careful pruning, and even then only short sections will be potential timber because of the irregular shape of the trunk.

Milo trees grown in dry areas, as with any trees, would ben-

efit from application of mulch and initial watering. Mulch around seedlings helps retain moisture in dry areas and keeps down weeds. The mulch should be kept well away from the trunk to avoid rotting. Once established, the trees are relatively drought tolerant.

### Nuisance issues

Milo can be considered a “messy” tree and drops its dry seed capsules year-round. Milo is a prolific seeder, and a carpet of seedlings may spring up under mature trees. This may be a problem if the seedlings need to be weeded out of a ground cover. Milo wood is valuable enough that trunks of large old trees may be poached for the timber.

### Hazards

None.

### Common pest problems

Milo has few pest problems, and these can usually be managed by maintaining good tree health.

## COMMERCIAL PRODUCTS

In Hawai‘i the wood is mainly used today for bowls and other craft items. Wood turners create attractive patterns

in their creations by including some of the lighter colored sapwood to contrast with the darker colored hardwood. In the Cook Islands, mīlo is used for carvings of traditional religious figures and decorative but useful items such as small stools. These items are sold to visitors and provide a livelihood for a few carvers and a link to the islands’ culture and its past. Islanders from Pitcairn Island, having depleted local forests of mīlo, sail to Henderson Island once a year obtain mīlo and kou (*Cordia subcordata*) for carving to earn income.

### Spacing for commercial production

Milo is more often grown as an ornamental tree or as a windbreak tree than for timber, and wood production tends to be incidental to the tree’s other uses. When planted as a windbreak, mīlo should be combined with a taller, thinner-canopied tree such as *Casuarina*. The wood is valuable enough that single trees are harvested.

### Management objectives

Weeding is essential until the trees become established. Watering improves survival in droughty locations. Milo is naturally very branchy, and trees should be pruned to help develop clear boles for timber production.



**Poor form and slow growth make mīlo a questionable investment solely for timber. Careful pruning can increase yields of usable timber and thereby the economic prospects.** PHOTOS: C. ELEVITCH

## Advantages and disadvantages of polyculture

Milo naturally occurs as part of a mixed-species stand. It does not tolerate shading and should not be grown with other trees that will overtop and shade it.

## Yield

While no numbers on an economic rotation for milo are available, trees will likely take 25–40 years before attaining a size large enough to produce usable timber. Only the heartwood is valuable, although sometimes small amounts of sapwood are included in turned or carved pieces for decorative effect.

## Market

Milo lumber is cut to short lengths (60–120 cm or 2–4 ft) and narrower than usual because of the small size of the logs. Lumber in Hawai'i retails for about US\$15–20 per board foot. Bowl stock, short sections of logs used for wood turning, is sold per lineal foot, with 20 cm (8 in) diameter stock selling for \$48/ft, 25 cm (10 in) diameter stock selling for \$84/ft, and 45 cm (18 in) diameter stock selling for \$336/ft. Board foot equivalents for bowl stock work out to \$25–30/bf.

## INTERPLANTING/FARM APPLICATIONS

### Example system 1

#### Location

Kipū, Kaua'i, Hawai'i.

#### Description

A new plantation was established on private land in 1998 on deep, acid, clay soils (Typic Umbriorthox, USDA classification); elevation 125 m (415 ft); windy; average annual rainfall 1100 mm (43 in); temperature range 18°C to 30°C (65°F to 86°F). Trees were weeded as needed and given initial fertilization for the first 3 years.

#### Yields

Milo trees grew an average of 3.7 m (12.1 ft) in height and 3.0 cm (1.2 in) diameter in 4.5 years, with the tallest tree reaching 4.4 m (14.5 ft) in height and 5.3 cm (2.1 in) diameter at breast height. All 24 trees planted in the trial survived, but growth and form were only rated fair.

#### Crop/tree interactions

Trees were planted in a single-species stand adjacent to stands of kou (*Cordia subcordata*), kamani (*Calophyllum inophyllum*), and bamboo (*Bambusa arundinacea*).

## Spacing

Trees were planted in a double row at 1.8 x 3.4 m spacing (6 x 11 ft).

### Example system 2

#### Location

Moloka'i, Hawai'i

#### Description

An alley cropping demonstration was planted by the University of Hawai'i on former agricultural land on the island of Moloka'i in 1995 with milo, kamani (*Calophyllum inophyllum*), kou (*Cordia subcordata*), and kukui (*Aleurites moluccana*). The site is dry and windy, with only 460–530 mm (18–21 in) of rainfall annually, and is 150 m (500 ft) above sea level. The trees receive supplemental irrigation. The soil is classed as a Typic Torrox in the USDA classification, pH 6.5. Alfalfa for forage was grown among the trees until the canopies closed; after that, a number of shade-tolerant crops were planted, including ornamental ginger, edible mushrooms, kava, and cacao.

#### Yields

Tree growth was satisfactory; milo trees averaged 7.2 m (24 ft) in height with the tallest growing 8.7 m (29 ft) in 7 years. The constant high winds have caused the trees to lean over, however, and the effect of the stress on wood quality is unknown. Crop production is less than would be expected in full sun but nonetheless significant.

#### Crop/tree interactions

Crop yield, even for the shade-tolerant crops (except for the edible mushrooms), is reduced because of shading. However, the trees also serve as windbreaks, without which fragile crops such as kava would not grow at all. The crops receive supplemental irrigation, which also benefits the trees.

#### Spacing

The trees were planted in wide rows 4.5 m (15 ft) apart with 3 m (10 ft) spacing within the rows.

### Example system 3

#### Location

Wai'anae, O'ahu, Hawai'i.

#### Description

This site was established in the 1960s as part of a program by the U.S. Forest Service to select trees for reforestation in Hawai'i. The site is dry, with average annual rainfall



Seven-year-old milo trees in an alley cropping system on Moloka'i, Hawai'i, with ornamental gingers grown as an understory crop. Note leaning caused by persistent trade winds. PHOTO: J. B. FRIDAY

700 mm (28 in) with prolonged summer dry periods, on a slightly acid to neutral clay soil (Lualualei series, Typic Chromustert, USDA classification). The site was 8 km (5 mi) east of the coast at an elevation of 177 m (580 ft).

#### Yields

Survival at 5.6 years was 93%; heights ranged from 1.85 to 4.3 m (6–14 ft) with an average height growth of 60 cm/yr (2 ft/yr).

#### Crop/tree interactions

The milo was part of a multiple-species trial that included 16 other species. The fastest growing trees in the trial were *Eucalyptus camaldulensis* and *Phytolacca dioica*. Milo did not survive in another trial in the same area but at a lower elevation (75 m [250 ft]) and rainfall (500 mm [28 in]).

#### Spacing

Trees were planted at a 1.5 x 2.4 m (5 x 8 ft) spacing and weeded as needed but not fertilized or watered.

## PUBLIC ASSISTANCE AND AGROFORESTRY EXTENSION

Milo has been identified as a priority species for further genetic research and conservation by the South Pacific Regional Initiative on Forest Genetic Resources (SPRIG).

Extension offices for agroforestry and forestry in the Pacific: <http://www.traditionaltree.org/extension.html>.

## INTERNET

A description of the use of milo in old Hawai'i: <<http://www.canoepplants.com>>.

For a detailed description of milo propagation, see the Native Plants Network: <<http://www.nativeplantnetwork.org>>.

For photographs and overall information on milo, see the National Tropical Botanical Garden, Hawai'i: <<http://www.ntbg.org/pwr/tree/>>.

For a general article on milo, see Australian Native Hibiscus: <<http://www.hibiscus.org/species/tpopulnea.php>>.



For information on milo as an invasive species in new areas, see Identification and Biology of Non-Native Plants in Florida's Natural Areas, University of Florida: <<http://www.fleppc.org/pdf/Thespesia%20populnea.pdf>>.

Examples of wood carving using milo in the Cook Islands: <<http://www.atiutourism.com/carving.htm>>.

Propagation tips: <<http://www2.hawaii.edu/~eherring/hawnprop/the-popu.htm>>.

University of Hawaii College of Tropical Agriculture and Human Resources Landscape Series <<http://www.ctahr.hawaii.edu/freepubs>>.

How to Prune Trees, USDA Forest Service: <[http://www.na.fs.fed.us/spfo/pubs/howtos/ht\\_prune/prunoor.htm](http://www.na.fs.fed.us/spfo/pubs/howtos/ht_prune/prunoor.htm)>.

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Traditional Tree Initiative—Species Profiles for Pacific Island Agroforestry ([www.traditionaltree.org](http://www.traditionaltree.org))

## *Thespesia populnea* (milo)

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