

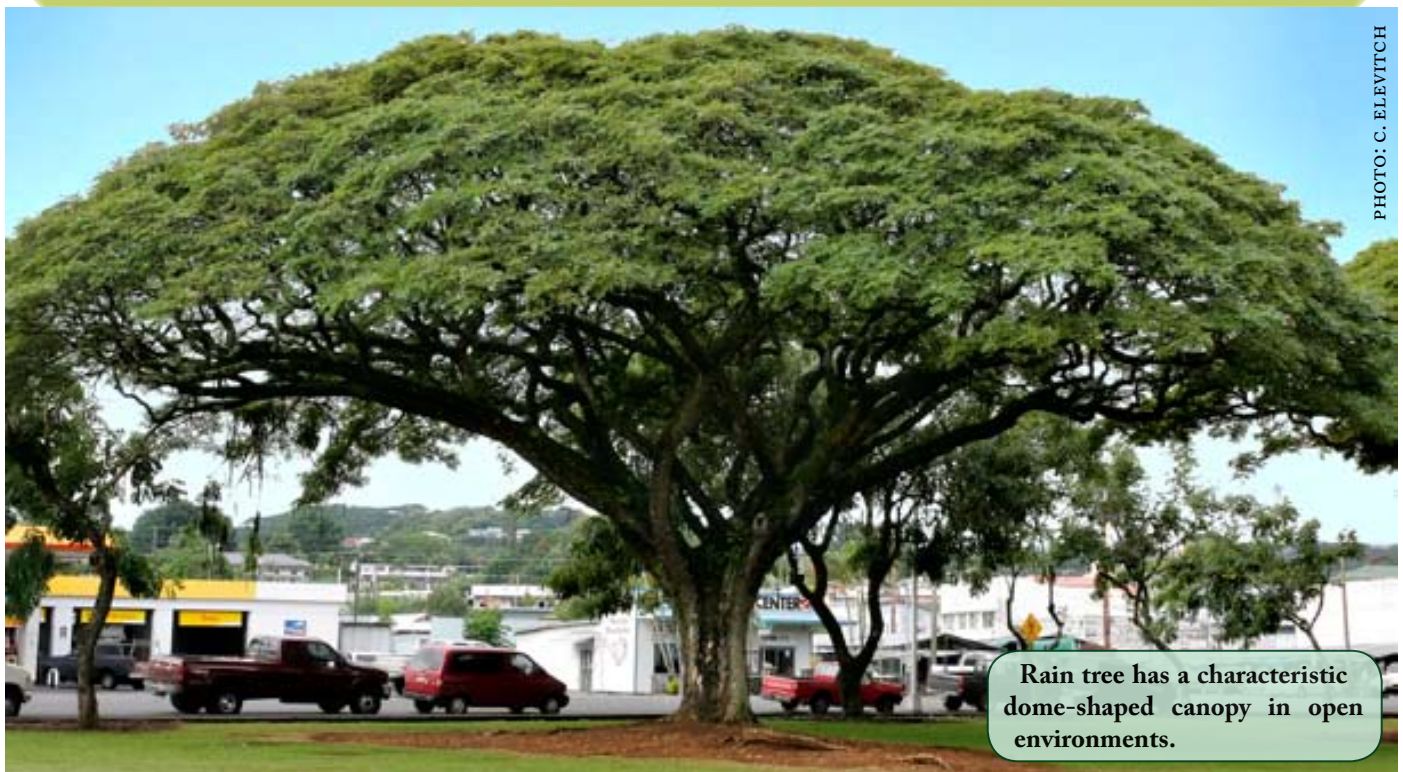


Samanea saman (rain tree)

Fabaceae (legume family)

filinganga (Northern Marianas); *gouannegoul*, *saman* (French); *gumorni spanis* (Yap); *kasia kula*, *mohemobe* (Tonga); *marmar* (New Guinea); *'ohai* (Hawai'i); rain tree, monkey pod, saman (English); *tamalini*, *tamaligi* (Samoa); *trongkon-mames* (Guam); *vaivai ni vavalangi*, *sirsa* (Fiji)

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Rain tree has a characteristic dome-shaped canopy in open environments.

IN BRIEF

Distribution Native to northern South America, and now naturalized throughout the tropics.

Size Typically reaches 15–25 m (50–80 ft) tall with a broad crown typically 30 m (100 ft) in diameter.

Habitat Grows best in the lowlands from sea level to 300 m (1000 ft) with rainfall 600–3000 mm (24–120 in).

Vegetation Naturally occurs on savannahs (grasslands) and in deciduous forests and riparian corridors.

Soils Adapts to a wide range of soil types and pH levels.

Growth rate Moderately fast growing with growth rates of 0.75–1.5 m/yr (2.5–5 ft/yr) per year.

Main agroforestry uses Silvopasture, crop shade.

Main products Fodder, timber.

Urban forestry Well suited for large public areas such as parks, school grounds, etc., and large homesteads.

Yields A 5-year-old tree can produce 550 kg (1210 lb) of green forage; timber yields of 10–25 m³/ha/yr (1715–4290 bf/ha/yr) under a 10–15 year rotation.

Intercropping Interplanted as a shade tree with coffee, cacao, and other crops.

Invasive potential Considered invasive in Fiji and Vanuatu, elsewhere in the Pacific it is naturalized but rarely considered to be problematic.

INTRODUCTION

Rain tree (*Samanea saman*) is easily recognized by its characteristic umbrella-shaped canopy. When grown in the open, the tree usually reaches 15–25 m (50–80 ft) in height with a canopy diameter wider than the tree is tall. Rain tree is most important in the Pacific as a shade tree on small farms, along roads, in parks and pastures. The wood has limited use for carved bowls in local markets; it could be developed more widely as a commercial timber, comparing favorably to black walnut. A multitude of minor uses is documented for rain tree, most of them of purely local significance, but all could be explored for wider applicability. Rain tree naturalizes freely almost everywhere it has been introduced and is considered an invasive pest in Vanuatu and Fiji. In many other places naturalized rain tree is not considered a problem.

DISTRIBUTION

Native range

Extensive cultivation has obscured the native range of rain tree. It is believed to be native in northern South America (Colombia, the Caribbean slope and the Orinoco drainage of Venezuela), and in Central America as far north as El Salvador. It is now widespread from Mexico south to Peru, Bolivia, and Brazil. In these areas, it occurs in low-elevation dry forests and grassland/savannah habitats.

Current distribution

Rain tree is cultivated and naturalized throughout the tropics. In the Pacific, rain tree is known to occur on the following islands: American Samoa (Tutuila), Commonwealth of the Northern Mariana Islands (Saipan, Rota), Federated States of Micronesia (Chuuk, Kosrae, Pohnpei), Fiji (Kanacea, Taveuni, Vanua Levu, Viti Levu), French Polynesia (Îles Tubuai [Rurutu], Tahiti, Marquesas, Moorea, Raiatea), Guam, Hawai'i, Marshall Islands (Jaluit, Kwajalein), Niue, Palau (Koror), Papua New Guinea, the Philippines, Pitcairn, Rotuma, Samoa ('Upolu), and Tonga (Tongatapu, 'Eua, Vava'u, Lifuka/Foa). The species is also naturalized in a number of the Caribbean Islands including Puerto Rico. It is almost certainly even more widespread than the foregoing list indicates.

BOTANICAL DESCRIPTION

Preferred scientific name

Samanea saman (Jacquin) Merrill

Family

Fabaceae (alt. Mimosaceae), legume family

Subfamily

Mimosoideae

Non-preferred scientific names

Albizia saman (Jacquin) F. Mueller
Enterolobium saman (Jacquin) Prain ex King
Inga salutaris Kunth.
Inga saman (Jacquin) Willd
Mimosa saman Jacquin
Pithecellobium saman (Jacquin) Bentham

Common names

Pacific islands

filinganga (Northern Marianas)
gouannegoul, saman (French)
gumorni spanis (Yap)
kasia kula, mohemohe (Tonga)
marmar (New Guinea)
'ohai (Hawai'i)
rain tree, monkey pod, saman (English)
tamalini, tamaligi (Samoa)
trongkon-mames (Guam)
vaivai ni vavalangi, sirsa (Fiji)

Other regions

acacia, palo de China (Philippines)
algarrobo, algarrobo del país, carrito negro, delmonte, dormilón, guannegoul, samán (Spanish)
gouannegoul, saman (French)

Size

Rain tree generally attains maximum heights of 15–25 m (50–80 ft). In rare cases it can reach a height of 50 m (160 ft). The crown typically reaches 30 m (100 ft) in diameter. Very large trees may reach 50–60 m (160–195 ft) in diameter. Rain trees usually have a short, stout trunk of about 1–2 m (3–6.5 ft) in diameter at breast height (dbh), but the trunk can attain 2–3 m (6.5–10 ft) dbh in exceptional cases. Under dense planting conditions, trees may attain greater height (to 40 m, 130 ft) with a narrower crown diameter than when planted in the open.

Form

Rain tree has a distinctive, umbrella-shaped crown. The crown is typically broad and domed; the horizontal spread is greater than the height when grown in spacious, open settings. Under plantation conditions, the crown is more vase-shaped.

RAIN TREE?

The name rain tree has been attributed to:

- The leaflets are light-sensitive and close together on cloudy days (as well as from dusk to dawn), allowing rain to fall through the canopy to the ground below.
- The grass is often much greener under a rain tree than the surrounding grass.
- A steady drizzle of honeydew is often created by sap-sucking insects.
- Nectaries on the leaf petioles excrete sugary juice that sometimes falls from the tree like rain.
- During heavy flowering, stamens can drop from the canopy like rain.

Flowers

The tiny flowers (12–25 per head) are massed in pinkish heads 5–6 cm (2–2.4 in) across and about 4 cm (1.6 in) in height. The long, bicolored stamens (white in lower half and reddish above) give the whole inflorescence the appearance of a powder puff or feather duster held slightly above the foliage. Thousands of heads are borne at the same time, covering the tree in pinkish bloom. The central flower in each head is larger, stalkless, has more petals, and is incapable of forming a fruit; this flower is a nectar-producing organ that attracts pollinators. Usually only one flower per head (rarely two) is pollinated and forms a fruit.

Leaves

Leaves are alternately arranged along twigs and have a prominent swelling (pulvinus) at the petiole base; stipules are present and threadlike; the leaf blades are twice-even-pinnately compound, arranged in 2–6 pairs of pinnae, each pinna bearing 6–16 diamond-shaped leaflets, shiny green above, dull and finely hairy beneath, 2–4 cm (0.8–1.6 in) long and 1–2 cm (0.4–0.8 in) wide, the apical leaflets largest. During dry periods trees are semi-deciduous, losing their leaves for a short period. Where there is a definite dry season, they may remain leafless for a period of weeks but refoamate quickly if there is adequate moisture. This gives the appearance that rain tree is “evergreen” in moister climates.

Fruit

Mature pods are black-brown, oblong, lumpy, 10–20 cm long (4–8 in), 15–19 mm (0.6–0.8 in) wide, ca. 6 mm (0.25 in) thick, straight or slightly curved, not dehiscent but eventually cracking irregularly, and filled with a sticky, brownish pulp that is sweet and edible.



Top: Flowers and new leaves. Bottom: Fruit in varying stages of ripeness. PHOTOS: C. ELEVITCH



Rain tree makes a remarkable habitat for epiphytes such as ferns and orchids, particularly in wetter areas. PHOTO: C. ELEVITCH

Seeds

Seeds are plumply oblong-ellipsoid, 8–11.5 mm (0.3–0.45 in) long, 5–7.5 mm (0.25–0.38 in) wide, slightly flattened from side to side, smooth, dark glossy brown with a slenderly U-shaped yellowish marking (pleurogram) on the flattened sides. There are 15–20 seeds per pod (often only 5–10 seeds per pod in the native range, where seed predation by insects accounts for the rest). One kilogram of seeds averages 4000–6000 seeds (1820–2730 seeds/lb). Seeds are readily dispersed by domestic livestock (cattle, hogs, goats) and to a much lesser extent by wild animals (peccary, tapir, and rodents in the presumed native range), whose feeding habits and digestive capacity permit very few seeds to pass through intact. It has been hypothesized that rain tree fruits evolved for dispersal by large mammals that became extinct in the Americas during the Pleistocene glaciations. Cattle and other herbivorous domestic animals efficiently fill the seed dispersal role today.

Bark

The bark of mature trees is gray, rough, and fissured in long plates or corky ridges. On younger trees the bark is smoother and paler gray to brownish in color. The inner bark is light colored and bitter.

How to distinguish from similar species/look-alikes

Rain tree is not easily confused with any other tree in the

Pacific. The broadly domed, umbrella-shaped crown, squat, thick trunk, pinnately compound leaves with diamond-shaped leaflets that fold up at night or on cloudy or rainy days, pinkish “powder puff” flower heads, and indehiscent blackish pods filled with sticky, pitch-like pulp are distinctive. What appears to be a white-flowered form of rain tree in Hawai‘i is a different species, *Pseudosamanea guachapele*. It is rare in cultivation but where it is grown it has been confused with rain tree when flowering. The seedlings and saplings of rain tree can be confused with those of *Albizia lebbek*.

GENETICS

Variability of species

Rain tree is remarkably uniform in appearance throughout its distribution and shows little local variability. No taxonomic varieties have been recognized among wild *Samanea saman*, nor have foresters or plant breeders named any cultivars.

Culturally important related species in the genus

There are two other species of *Samanea* (*S. tubulosa* and *S. inopinata*); neither has any reported cultural importance in the Pacific islands.

Genetic resources where collections exist

The Oxford Forestry Institute includes *Samanea saman* in its germplasm conservation program. However, neither germplasm collections nor breeding programs are known to exist for rain tree.

ASSOCIATED PLANT SPECIES

In native habitat

Rain tree is found naturally in savannahs, where it is associated with various grasses. It also occurs in deciduous forests and riparian corridors, where it often bears a heavy load of epiphytes on the trunk and branches.

Recent introduction

In places where rain tree has been introduced, it is often planted along roadsides, in parks and pastures, vacant lots, church and schoolyards, and similar spacious, open places. In these locations, it grows in association with an array of

cultivated and weedy alien species that characterize disturbed habitats and planned landscapes.

ENVIRONMENTAL PREFERENCES AND TOLERANCES

Climate

Although originating from a part of tropical America that has a pronounced, seasonal dry climate, rain tree is highly adaptable and has proven able to thrive in many tropical and subtropical climate regimes. Today the species is successfully established in a wide range of climates, including both ever-wet (equatorial) and seasonally dry (monsoon) climates that have an annual rainfall of 600–3000 mm (24–120 in) and at elevations ranging from sea level to 300 m (1000 ft) (exceptionally to 1450 m [4750 ft]).

Elevation

In its native range, rain tree grows mostly below 450 m (1470 ft) although the total elevation range is reported to be sea level to 1450 m (4750 ft). In Pacific islands, this species typically is found below 300 m (1000 ft).

Mean annual rainfall

600–3000 mm (24–120 in)

Rainfall pattern

Rain tree can tolerate a wide range of precipitation patterns, including summer, winter, bimodal, and uniform rainfall patterns. In its native range, rain tree often grows along riparian corridors where its roots have access to subsurface moisture, making precipitation less critical.

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

Rain tree can survive a dry period of 2–4 months or longer depending on age, size of tree, temperature, relative humidity, and soil.

Mean annual temperature

20–38°C (68–100°F)

Mean maximum temperature of hottest month

24–38°C (75–100°F)

Mean minimum temperature of coldest month

18–20°C (64–68°F)

Minimum temperature tolerated

8°C (46°F)

Soils

Rain tree adapts to a wide range of soil types and pH levels.

Soil texture

Rain tree is indifferent to soil texture; it tolerates a wide range of light, medium, and heavy soils.

Soil drainage

Rain tree thrives in soils that are freely draining, and it tolerates impeded drainage. In some situations, it can tolerate waterlogged soils for short periods. Rain tree is known to grow on slightly elevated land just inland from mangroves (Francis 2004).

Soil acidity

Rain tree thrives in mildly acidic to neutral pH (6.0–7.4), but the literature reports that it tolerates pH as high as 8.5 and as low as 4.7 (such as soils that had been mined for bauxite with highly acidic residues).

Special soil tolerances

Rain tree tolerates shallow soils and soils low in available nutrients.

Tolerances

Drought

Rain tree grows well under climates having a seasonal dry period (2–4 months) as well as under moister conditions where rainfall is distributed evenly year-round. It does not tolerate extended periods of drought.

Full sun

The tree is light-demanding. It is rarely found in dense forest stands; its natural habitat is savannah land, seasonally dry, deciduous forest, and riparian forest corridors.

Shade

Rain tree is intolerant of shade. Seedlings may be grown for 2–4 weeks in partial shade and then gradually shifted to full sun. The seedlings cannot survive below closed stands of other trees. When rain trees are found in mixed stands, they started with or before the other species in the stand. Seedlings are suppressed and killed by dense stands of tall grasses such as Guinea grass (*Panicum maximum*) and elephant grass (*Pennisetum purpureum*) (Francis 2004).

Frost

It cannot tolerate frost or low temperatures.

Waterlogging

Reports vary as to rain tree's ability to tolerate waterlogging. Some observers report that good drainage is essential; others state that rain tree survives impeded drainage and waterlogging.

Salt spray

Wind-blown salt spray may cause tip-burn on the windward side of trees, but this causes only cosmetic damage.

Wind

In Hawai'i, rain tree adapts well to trade winds, although lopsided crowns may develop in exposed situations. Storm winds may uproot and topple rain tree, as it is shallow-rooted. Where sandy or gravelly soils allow deep rooting, the species is fairly resistant to hurricane-force winds, suffering limb breakage but not much windthrow (toppling over) or snapping of the trunk. Pavement, foundations, or shallow bedrock restrict root growth and make the species vulnerable to windthrow (Francis 2004).

ABILITIES

Fix nitrogen

Rain tree fixes nitrogen through an association with strains of rhizobia bacteria (*Bradyrhizobium*). In pasture systems, rain tree enhances growth of grasses below and near the tree canopy through nitrogen enrichment of the soil.

Regenerate rapidly

Rain tree produces seed copiously and natural regeneration is quite dependable. Although predators destroy many seeds, there are so many produced that the next generation is assured. In old fields, or anywhere that sunlight and open ground are available, the tree regenerates spontaneously.

Self-prune

The tree usually has a short bole with heavy side-branching. Even when planted in dense stands, lower branches are often retained.

Coppice

Rain tree has very good coppice ability, although the regrowth rate is moderate, slower than other nitrogen-fixing species such as *Leucaena* spp., *Gliricidia sepium*, etc. In Thailand the tree is cut at 1 m (3.3 ft) height every 6 months for production of fodder.

Pollard

Trees in Hawai'i are often "hat-racked" by tree trimmers, who remove all leafy shoots back to main branches. Trees

resprout vigorously and within 12–15 months have a dense, compact crown of new growth.

Other

Medium sized trees can be pruned back severely and moved fairly easily for landscaping purposes.

GROWTH AND DEVELOPMENT

Rain tree is a moderately fast-growing tree with typical growth rates of 0.75–1.5 m/yr (2.5–5 ft/yr). Nursery-grown seedlings 3–5 months old are usually 20–30 cm (8–12 in) tall when ready for outplanting. Initial growth is slow but survival is good. Two months after transplanting, seedlings begin to look vigorous and grow rapidly. Two-year-old saplings in mixed plantations attained 2.9 m (9.5 ft) in height and in monospecific plantings at a 3 x 3 m (10 x 10 ft) spacing reached 4.8 m (16 ft) tall and 6.6 cm (2.6 in) dbh. Well tended specimens may attain 15 cm (5.9 in) diameter in 5 years.

Flowering and fruiting

Flowering begins at a young age and has a definite seasonality, beginning at the end of the dry season (March–April in Hawai'i) just after the leaves and mature pods drop. New foliage flushes out and flowering begins more or less simultaneously (April–May in Hawai'i). In its native range flowering occurs January–May, while in Thailand there are two flowering seasons, February–May and September–November, and in Java flowering occurs August–April. Although flowering tends to peak in the spring, trees may have flowers present in almost any month of the year, especially in areas with year-round rainfall.

Yields

Mature trees bear, on average, 200–250 kg (440–550 lb) of pods per tree, per season. Wood yields average annually 25–30 m³/ha (4290–5140 bf/ac). When grown as a green fodder, it is possible to harvest 550 kg (1210 lb) from a 5-year-old tree.

Rooting habit

The tree has a massive surface root system. The large surface roots common in the species occur most often on clayey and rocky soils but are not as extensive on sandy or gravelly soils.

Reaction to competition

Once established, rain tree seedlings grow fast and are tolerant of heavy weed competition. However, survival and



Large trees, as well as seedlings, can be transplanted readily by pruning the roots and branches, and ensuring sufficient irrigation for a few months.

PHOTO: C. ELEVITCH

growth rates are improved if vigorous weed control is done until the saplings are taller than the surrounding grasses and herbaceous vegetation.

PROPAGATION

Rain tree is easily propagated by several methods. It may be propagated by seed (the usual method), stem cuttings (using vertical stems), root cuttings, and stump cuttings. In much of the Pacific, however, no special effort is exerted to grow rain tree. If one or a few trees are wanted for home use, seedlings are dug from near a mature tree and transplanted to the garden. Even very large trees can be successfully transplanted with substantial root and top pruning and proper care. Seedlings are also encouraged to grow where they sprout by protecting them and providing some weed control. When larger numbers of trees are required, seed is collected for nursery planting or direct sowing in the field.

Propagation by seed

Seed collection

Pods are collected from the ground beneath trees after they drop; picking pods off the tree is inadvisable because, although the pods take 5.5–8 months to mature, the seeds only fill out and become viable shortly before the pods fall. In some cases the pods are retained on the tree for up to 4 months past maturity.

Seed processing

In Latin America, seeds are manually extracted from the sticky, pitch-like pulp inside the pods. An easier method is to collect seeds from dung of livestock that has eaten the pods; in addition to being less labor intensive, germination is enhanced by passage through the digestive tract of herbivores. In Asia, the pods are placed in a dark place where termites eat the fruit valves and pulp, leaving behind clean seed.

Seed storage

The sweet, sticky fruit pulp (endocarp) promotes an intense insect attack, so careful cleaning of seed is vital before storage. Rain tree seed behavior is orthodox, that is, the seeds retain viability when dried and stored. Seed can be stored for extended time periods at 4°C (39°F) with 6–8% moisture content. Seed stored at 5°C (41°F) or colder retains viability longer than a year.

Pre-planting seed treatments

Fresh seed germination is about 36–50% with no treatment. Germination of untreated seed increases in the course of the first year of storage. Germination is also enhanced by passage of the seeds through the digestive tract of herbivorous animals. Scarification is not essential although it is recommended to ensure fast, uniform, and optimal germination. Manual nicking of the seed coat using a nail clipper or small file works very well, although it is time consuming. Alternatively, immerse the seed for 1–2 minutes in 80°C (176°F) water (water volume 5 times the seed volume). Stir the seeds, then drain and soak them in lukewarm (30–40°C [86–104°F]) water for 24 hours. This method yields 90–100% germination if damaged seeds are removed prior to treatment.

Growing area

Studies indicate that rain tree seedlings are intolerant of shade. Some literature sources recommend partial shade for seedlings in the first 2–4 weeks after emergence and then full sun; other sources state that seedlings should be placed in full sunlight from the beginning.

Germination

Germination occurs 3–5 days after sowing scarified seeds. Pretreatment, although not essential, results in more uniform germination and improves the percentage of seeds that germinate.



Seeds in pod. Note sticky pulp surrounding the seeds. PHOTO: C. ELEVITCH

Media/containers

Seeds may be planted in sand in nursery beds; in nursery mix (3 parts soil: 1 part sand: 1 part compost) in poly bags 10 x 20 cm (4 x 8 in); or direct-seeded in the field.

Time to outplanting

Seedlings are ready for outplanting 3–5 months after germination, by which time they should be 20–30 cm (8–12 in) tall. Seedlings with thick stems, more than 10 mm (0.4 in) in diameter, hold up better to wind and rain.

Approximate size at time of outplanting

Seedlings may be planted out when they have attained a height of 15–30 cm (6–12 in). They may be “stumped” by pruning the roots to a length of 10 cm (4 in), and the stem to a length of 20 cm (8 in). The stem diameter of stumped seedlings should be 5–30 mm (0.2–1.2 in).

Other comments on propagation

Caterpillars can defoliate young seedlings.

Guidelines for Outplanting

Survival and establishment after outplanting improve with vigorous weed control until saplings are taller than the surrounding vegetation and begin to shade it out.

DISADVANTAGES

Rain tree becomes very large, and this limits its utility in some situations, especially in proximity to human activity. The massive branching habit and surface root system can interfere with agricultural activities. For example, the root system may compete too well for moisture and nutrients in agroforestry systems with small trees or shrubs underneath.

Due to the shallow root system, the tree is also susceptible to windthrow during storm winds, and in pasture systems this can be dangerous to livestock. Copious seed production and prolific reproduction in the Pacific have helped rain tree naturalize in many places where it has been introduced. The sticky pods and mess of leaf litter are a nuisance when the trees enter the deciduous phase. However, where grazing animals are present, virtually every pod will be consumed.

Potential for invasiveness

Rain tree has naturalized in many places outside its native range and, in the Pacific, is considered a serious pest in Vanuatu and Fiji. Elsewhere in the Pacific it is regarded as innocuous. For example, it is common in Samoa in plantations but does not readily spread to other areas. The precise nature of the threat posed by rain tree has not been articulated; it may simply be a nuisance tree that grows where it is not wanted. The rapid spread and spontaneous appearance of the species in sites distant from seed sources is usually due to dissemination by cattle. Copious seed production and ease of seed dispersal by livestock has the potential to pave the way for rain tree to become a pest in other parts of the Pacific. However, when cattle are present year-round or return at least annually, they consume and kill almost all small rain tree seedlings.



Rain tree has an extensive surface root system, which may interfere with agricultural activities or landscape maintenance especially on clayey or rocky soils. PHOTO: C. ELEVITCH

Susceptibility to pests/pathogens

Lepidopteran caterpillars (*Ascalapha odorata*, *Melipotis indomita*, and *Polydesma indomita*) defoliate rain trees in many places as they leaf out but without causing serious stress to healthy trees. *Ascalapha odorata*, *Mocis latipes* (lepidopteran) defoliate seedlings; *Myrmelachista ramulorum* (ant) defoliates and deforms leaves by burrowing in twigs; *Merobruchis columbinus* (bruchid beetle) oviposits in immature fruits and the larvae damage or kill 50–75% of seeds; *Cecidomyiidae* (fly) oviposits in immature fruits and causes abortion; *Anypsipyla univittella* (lepidopteran) oviposits in fruit and damages seeds and pods; *Stator limbatus* (beetle) oviposits in seeds in opened pods; *Heteropsylla cubana*, *Psylla acacia-baileyanae* defoliate trees; *Xystrocera globosa* (borer) attacks sapwood of stressed trees; seedlings are browsed/defoliated by livestock; fruits in the wild are eaten by parrots, tapirs, collared peccaries; flowers are eaten by howler monkeys.

AGROFORESTRY/ENVIRONMENTAL PRACTICES

Today rain tree is grown for nitrogen enrichment of soils in pastures, for shade along streets and roads, in parks, and as a flowering ornamental. It has also long been grown for shade in plantations of coffee, cocoa, and other crops.

Mulch/organic matter

The green foliage and leaf/flower litter that collects beneath the trees makes an excellent nitrogen source for enriching the soil as well as for composting in gardens. It can be periodically pruned for mulch. Because regrowth is relatively slow compared with other nitrogen-fixing trees such as *Gliricidia sepium*, *Calliandra calothyrsus*, and *Leucaena leucocephala*, it is usually not the best choice for this purpose.

Crop shade/overstory

Rain tree is planted for shade in plantations of coffee, cocoa, vanilla, and for young nutmeg and teak.

Alley cropping

Rain tree can be used in alley-cropping if heavily pruned, but it is rarely the most productive species choice for this purpose.



Rain tree is a common ornamental, particularly in public places. PHOTO: C. ELEVITCH

Homegardens

Rain tree can be used in homegardens as a shade tree and for the multiple products it provides, but its immense size limits its use in most urban areas.

Living fences

It can be maintained as a hedge plant with regular heavy lopping.

Windbreaks

Trees provide windbreak in coffee orchards and pastures.

Silvopasture

Rain tree is an excellent choice for pastures not only because its broad canopy provides shelter from the sun, but also because its nitrogen-fixing ability improves the quantity and nutritive quality of forage grasses near and under the trees.

Woodlot

The trunk and branches are used as firewood in places that have no market for the wood for carving or construction. In Central America, cross-sections cut through the trunk were formerly used to make wheels for ox carts.

Native animal/bird food

Wildlife in tropical America eats parts of the tree. The sweet fruit pulp and seeds are eaten by parrots, tapirs, collared peccaries, and rodents; the flowers are eaten by howler monkeys. Insects (moths, bees) visit the flowers as a nectar source.



Rain tree has a characteristic dome-shaped canopy in open environments such as this coffee orchard. PHOTO: C. ELEVITCH

Wildlife habitat

Various reptiles, birds, and small mammals use the tree branches and cavities for nesting and dens.

Host plant trellising

Vanilla is trained up the trunks of rain trees planted for shade.

Bee forage

The flowers, although pollinated in the natural range by nocturnal moths, are an abundant nectar source for bees.

Ornamental

Rain tree is widely planted throughout the tropics as a flowering ornamental shade tree in public places, parking lots, parks, etc.

USES AND PRODUCTS

Rain tree has long been a source of timber and livestock feed (green forage and pods) for local consumption. Minor medicinal and craft uses also are known. The wood is used for carving items for sale to tourists, and the seeds are strung in garlands.

Fruit

The sticky, licorice-flavored fruit pulp is a minor food item for humans, mainly eaten by children. It is known as licorice tree in the English-speaking Caribbean. Although the

pods have a nice flavor, they are too astringent to eat more than the pulp from a single pod.

Nut/seed

The seeds, once cleaned from the sticky fruit pulp, are used in making seed necklaces and other craft items in Hawai'i.

Animal fodder

With 13–18% protein, the pods are edible and nutritious for livestock and make an excellent feed supplement (Flores 2002). In Asia, rain tree is grown as a green fodder supplement for goats, sheep, and cattle. A 5-year-old tree can produce as much as 550 kg (1210 lb) of green forage. The pods are ground into a nutritious animal feed in several South American countries.

Beverage/drink/tea

The fruit pulp is used to make a beverage similar to tamarindo (made from tamarind pulp) in Latin America.

Medicinal

There are several folk remedies prepared from various parts of rain tree. The boiled bark is applied as a poultice to cure constipation. In the Philippines, a decoction of the inner bark and fresh leaves is used for diarrhea. In Venezuela, the roots are made into a hot bath for stomach cancer. In the West Indies, the seeds are chewed for sore throat.

Beautiful/fragrant flowers

Rain tree has been introduced to many tropical places for the beautiful masses of pinkish flowers it bears for extended periods.

Timber

The timber is valued for carvings, furniture, paneling, veneers, and is also used for turnery, posts, framing in boat building, plywood, boxes, and crates. The sapwood is narrow and white to light cinnamon. The heartwood is straight or cross grained with a medium to coarse texture. Air-dry specific gravity averages about 0.56. The wood requires careful drying because of shrinkage and moderate to severe warp. It is generally considered a durable wood and resistant to attack by drywood termites (Longwood 1971, Chudnoff 1984).

Fuelwood

In places where there is no demand for rain tree timber for construction or carving, the trunk and branches are used for firewood and charcoal. Although the wood makes good firewood, it burns with a lot of smoke even when very dry.

Craft wood/tools

The famous monkey pod bowls of Hawai'i and other souvenirs are carved from the wood. Rain tree wood was literally the basis for this industry beginning just after World War II ended (ca 1946).

Ornament/decoration

The seeds are used in making seed necklaces, jewelry, and other crafts in Hawai'i.

Canoe/boat/raft making

The wood is popular for large frame members in wooden boats.

Fiber/weaving/clothing

The wood has the right fiber properties for making paper. In the Philippines (Bulacan province), shavings made from the wood are made into hats.

Resin/gum/glue/latex

A low-grade gum exudes from wounded trees. It has no commercial use but may be used locally. In Thailand, rain tree is used as a food source for the lac insect (*Laccifer lacca*), the source of shellac.

Honey

Honey made from rain tree nectar is harvested

in several places for local consumption but is not an item of commerce.

URBAN AND COMMUNITY FORESTRY

Rain tree is beloved as a shade tree for avenue planting along streets, in parks, public grounds, and other spacious areas. It is too large for homegardens in urban areas but is suitable for smallholdings in rural areas with adequate space for the trees to develop their impressive crowns. Trees also produce multiple products—edible pods, leaf litter for mulching and composting as well as supplementary livestock feed, nectar for honey bees, wood for crafts and construction—that can be used in rural economies.

Size in an urban environment

Typical specimens of rain tree in Hawai'i attain heights of 15–20 m (50–65 ft) and crown diameters of 25–30 m (80–100 ft). This is too large for homegardens but suitable, and much used, for street tree plantings. Crowns have to be pruned and some surface roots removed periodically to prevent damage to pavement and sidewalks.

Rate of growth in a landscape

It is considered a fast-growing tree, although suboptimal conditions such as poor soil or restricted rooting area in urban areas often result in dwarfing effects on tree growth.



These large rain trees on the edge of a school playing field on Tongatapu island have canopies measuring over 60 m (200 ft) in diameter. PHOTO: C. ELEVITCH



The size of rain tree limits its use in crowded urban lots. However, if enough space is available, the tree makes a wonderful landscaping tree. PHOTO: C. ELEVITCH

Root system

Rain trees have shallow surface roots that thrust up above soil level as they mature, causing damage to pavements and sidewalks as well as building foundations if planted too close.

Products commonly used in a household

In Latin America, the sticky, sweet pulp from the pods is eaten by children and is made into a beverage in the same way as tamarind pulp. Wood from the trees is used for construction, making bowls and other household objects, cart wheels, boats, and furniture. Honeybees visit the trees when they are in bloom, and honey collected from hives is used for local consumption.

Light requirements

Rain tree has high light requirements; it thrives in full sunlight.

Water/soil requirements

Young trees should be irrigated after planting until they are fully established. Where sidewalks or pavement surrounds the tree, supplemental irrigation is beneficial; in open areas without obstruction to rainfall, normal precipitation is adequate for good growth.

Life span

Rain tree is long-lived; 80–100 years is average.

Varieties favored for use in homegardens or public areas

No varieties are known.

Use as living fence, hedge or visual/noise barrier

In the Pacific, rain tree is not used as a hedge or living fence. In Asia, the trees are used as a hedge, with heavy trimming required to maintain a compact growth form. Trimmings are used for livestock feed or green manure.

Birds/wildlife

Nectar from the flowers is utilized by bees and (in Hawai'i) by nectar feeding birds such as mynahs, cardinals, and bulbuls. The fruit pulp and seeds are eaten by rodents and ungulates—cattle, hogs, goats, sheep, deer—both domesticated and wild.

Maintenance requirements

Rain tree is maintenance-free once established. Occasional pruning to shape the crown and remove dead branches helps maintain an attractive specimen.

Special considerations

High winds will cause dead branches to drop or heavy live branches to break. Branches over structures should be removed. During the deciduous period when leaves and ripe pods fall and shortly thereafter when flowering begins, rain trees are messy. At this time cleanup of leaf litter and pods may be necessary.

Nuisance issues

When ripe pods are on the ground the sticky pulp causes pods and seeds to adhere to shoes and auto tires. This is more of an annoyance than a hazard.

Common pest problems in the landscape

Periodically there are heavy infestations of leaf-eating caterpillars that defoliate trees just after the new leaves emerge. Rain tree is sometimes attacked by coffee twig borer and a variety of other insect pests. These cause only cosmetic damage, and no treatments are required for such pest infestations.

Other comments

Urban community gardeners collect leaf litter from beneath rain trees in urban parks and use it for composting. The high nitrogen content of leaves and flowers adds to soil nitrogen.

COMMERCIAL PRODUCTS

Rain tree provides a number of products that are commercially important in local markets. Throughout its native and introduced range, the timber is prized for carving and turning. It is used in construction, for paneling, and in furniture making. Most timber consumption is local, although the demand for bowls made of the wood in Hawai'i is now supplied from Indonesia and the Philippines.

Spacing

It is seldom planted in single-purpose forestry stands, but it has been demonstrated that a close spacing, 6 x 6 m (20 x 20 ft), produces trees with a longer, straighter bole and fewer branches, although the trunk retains a curved form. Wider spacings can also be used for timber production, even in silvopasture. Wide spacing facilitates rapid growth in trunk diameter. Wood from large branches can also be used.

Management techniques

Rain tree seedlings are intolerant of shade and must be weeded until they are taller than the surrounding grass, which it will then shade out. Seedlings are susceptible to damage from herbicides used for weed control. In areas where animals are free to browse, seedlings should be fenced to protect them. When about 5 years old, a first thinning may be necessary, along

with pruning of lower branches to develop clear boles of commercial length.

Design considerations

There is no information recorded about designing commercial plantings of rain tree, other than one report of a failed attempt in Zanzibar that was blamed on too-close spacing (2 x 2 m [6.6 x 6.6 ft]) of seedlings. There is evidence that rain tree can grow too large to be utilized by the technology available in some locations (e.g., mills are too small to saw massive logs, etc.).

Advantages of polycultures

Production of rain tree is said to be better in mixed plantings than in single-species timber plantations.

Estimated yields

Few quantitative data are available. Total wood yields of 10–25 m³/ha/yr (143–358 ft³/ac/yr) under a 10–15-year rotation have been reported, although a much lower quantity of milled timber would be realized from small trees. Trees can be grown on short rotations, especially for fuelwood, but in silvopastoral systems rotations may advantageously be much longer, as the trees continue to produce prodigious crops of pods to a great age.

Markets

Two sources report that the crafts made of rain tree wood that are sold in Hawai'i to tourists are now largely imported from the Philippines and Indonesia. There is an indication that there is not enough local production of wood in Hawai'i to meet the demand for tourist curios.



Young rain tree planted for shade in a coffee orchard, Holualoa, Hawai'i.

PHOTO: C. ELEVITCH

INTERPLANTING/SILVOPASTURE

The tree is used in many regions to provide shade for coffee, tea, cacao, nutmeg, patchouli, and vanilla. It is also an important component in silvopastoral systems.

Benefits

Nitrogen fixation at roots improves soil nutrition. Grasses under and near rain trees remain luxuriant and green when nearby grasses in full sun wither and brown. Nutritional value of grasses grown under rain trees is improved. Rain tree is a valuable component of pasture systems for ranching, providing shade from heat and intense sun as well as nutritious pods that are 12–18% protein and 40% digestible. Pods are eagerly eaten by cattle, hogs, and goats; horses eat them if there is nothing else available but reject them if other foods are available. The leaves contain 22–27% crude protein and in some Asian countries are used as a livestock forage supplement for cattle, sheep, and goats.

Potential drawbacks of interplanting

Shallow roots, large branches and dense shade compete with companion crops, requiring heavy pruning to admit light.

PUBLIC ASSISTANCE AND AGROFORESTRY EXTENSION

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

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Traditional Tree Initiative—Species Profiles for Pacific Island Agroforestry (www.traditionaltree.org)

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