

TREE FERNS FOR HAWAI'I GARDENS
Norman Bezona, Fred D. Rauch, and Ruth Y. Iwata

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Cover: *Cyathea brentwoodii*, a popular horticultural variant, used in the landscape in Kona.

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TREE FERNS FOR HAWAI'I GARDENS

Norman Bezona, Fred D. Rauch, and Ruth Y. Iwata

The tree ferns are a large group of spectacular plants found in isolated pockets of tropical, subtropical, and warm, temperate forests (Figure 1). There are more than 800 species of tree ferns, but unfortunately many are on the verge of extinction. Tree ferns, including the Hawaiian genus *Cibotium*, are considered endangered and are protected by international laws regulating shipment of plants from one country to another. Unfortunately, this does not discourage destruction of tree fern habitats within a country by clearing, burning, grazing, or farming in their natural ranges. Tree ferns are unable to compete with aggressive grasses introduced to their natural ranges. This can be seen in wet areas of the Big Island of Hawai'i which were once predominantly covered by *Cibotium*, but are now open grasslands.

DESCRIPTION

Tree ferns have an upright habit of growth produced by a woody trunk or caudex. This trunk may vary from 1 foot to 70 feet in height, depending upon species and environment. The trunk is often hard on the outside with a soft, pithy center. At least part of the trunk is made of masses of aerial roots or fibers. It is topped with a crown of fine fronds (Figure 2).

Identification of species is determined by observing differences in the fertile fronds and the stipe, or frond base, including where it connects with the trunk. Presence of spines on the frond base and types of scales or hairs also help in the identification process (Figures 3 and 4).

Taxonomically, tree ferns belong to two families: Cyatheaceae and Dicksoniaceae.



Figure 1. Costa Rican tree ferns from Mt. Poas volcano found in a tropical rain forest setting with *Gunnera* sp.



Figure 2. The trunk of *Cyathea glauca* from Indonesia showing leaf scars and aerial roots. Note epiphytic orchids and bromeliads.



Figure 3. Example of armed leaf bases on *Cyathea mexicana*.

The family Cyatheaceae consists of 6 natural groups: *Sphaeropteris*, *Alsophila*, *Nephelea*, *Trichipteris*, *Cyathea*, and *Cnemidaria*. The Dicksoniaceae is a family of 5 genera: *Cibotium*, *Dicksonia*, *Thyrsopteris*, *Cystodium*, and *Culcita*.



Figure 4. Young *Cyathea cooperi* showing scales or hairs.

Members of the Cyatheaceae family have an arborescent habit, achieving a height of 60 feet or more and a crown spread of 20 feet. Members of the Dicksoniaceae family are not necessarily characterized by an erect stem. The stem may be arborescent or prostrate, stout to massive, and is usually unbranched (Figure 5). Leaves are usually large, up to 10 feet long (Figure 6). In both families, prominent leaf buds, called croziers, are formed at the stem apex.

Other ferns such as *Angiopteris*, *Blechnum*, and *Marattia* also develop trunks but are not true tree ferns.

The taxonomy of a large family such as Cyatheaceae is complex and controversial. Since there are about 6 natural groups, some taxonomists are inclined to separate these into genera. Others place these groups into a single genus, *Cyathea*. The current trend is to separate them into 6 individual groups. In the future, taxonomists may again decide to place these related ferns into a single genus.

PROPAGATION

A few tree ferns are recognized as important landscape plants and are propagated by commercial nurser-



Figure 5. *Cyathea glauca* growing in Kaloka Mauka, Kona, approximately 5 years old.

ies. Some *Cyathea* species are generally easy to produce from spores and grow quite fast. In comparison, *Dicksonia* species are generally slow growing. Some species such as *Cyathea baileyana* are very difficult to raise from spores. Measures to prevent contamination by mosses, algae, fungi, and other ferns are essential in propagation of fern spores. Fern spores may also be propagated using methods similar to propagation of orchids from seed.

Sporangia or spore cases of *Cyathea* species appear granular or crystalline when they are mature. In *Cibotium* and *Dicksonia*, the sori are hidden by indusia. A change in color of the indusium from green to brown signals maturity. Spore production may vary. Some species produce spores over much of the year, others seasonally, and still others vary from year to year.

Spores from hybrids are generally very difficult to grow, but intergeneric hybrids have been recorded involving *Alsophila-Nephelea* and *Cnemidaria-Cyathea-Trichipteris*.

It is best to sow spores that are fresh, but spores from some tree ferns will retain viability for several years when properly stored. Spores of *Cyathea australis* and



Figure 6. Young *Cyathea glauca* with leaves over 10 feet long at 5 years old.

Dicksonia antarctica reportedly remain viable for 10 to 15 years.

Some species of tree fern may be propagated by basal suckers, stolons, or offsets separated from the trunk. *Cyathea rebecca*, *Dicksonia youngiae*, *Dicksonia squarrosa*, and *Cibotium splendens* produce offsets on the trunk. *Cyathea baileyana* and *Cyathea rebecca* produce offsets from the base of the trunk. The offsets usually lack roots and may have 1 or 2 small fronds and undeveloped croziers. Since they are connected to the main trunk, they must be removed with a sharp knife. After removal, they must be protected from desiccation. The offsets can be potted in a coarse mixture, such as equal parts of sphagnum moss and cinders, and placed in a humid environment.

Offsets should be removed only during the spring when conditions for growth are ideal. The more well developed the offsets, the more readily they will establish themselves. Offsets generally accelerate in their development when the main apex is injured or the entire

trunk falls over.

The tree fern-like *Angiopteris* can be propagated by sowing stipules or appendages found at the base of the stipe. The stipules are laid at a slant, with the inner side up, in a well-drained media with bottom heat at 80° F. Plantlets can be potted when 2 to 3 leaves and roots have emerged.

The Hawaiian tree fern, *Cibotium glaucum*, is often propagated as cuttings. Cuttings, of any size, should be taken in the cool, early spring, before new fronds emerge. Leaves are removed and the cuttings taken and maintained in moist, cool conditions to allow the pithy, cut base to partially dry or suberize.

The natural habitats of *Cibotium glaucum* are the wet, cool areas of the islands. Site selection is important to ensure its establishment and healthy, continued growth. During establishment, the trunk should be kept moist and protected from desiccating winds. It should be planted in a well-drained soil and ensured of adequate water. In drier locations, tree ferns will grow better if given filtered light or some protection from intense sunlight during the heat of the day.

Cyathea species are usually more difficult to transplant than species of *Cibotium* and *Dicksonia*. A root ball should be dug with species of *Cyathea*.

Growing plants from spores can be challenging and requires a great deal of patience. Pick fronds when most of the sporangia are still plump. Collecting spores on a cool or overcast day reduces loss of spores or contamination from other species. Place fronds in an envelope or on a piece of paper with the sporangia side down and cover fronds to prevent shedding spores from blowing away. Mature spores will shed rapidly, often within a few minutes after collection. Other spores will take longer. Immature or old spores may not shed at all.

The spores will look like dust. Place them in a labeled envelope and store in cool, dry conditions until needed for sowing. A warm, dry atmosphere encourages quick and complete shedding of the spores. During cold or excessively humid weather, the shedding process is slowed down considerably and the spores may become damp and contaminated with fungi. Spores which have become damp during collection frequently have low viability. Some growers dry spores over a desiccant prior to storage.

To clean spores after they are shed, remove detritus or old debris such as indusia, scales, hairs, and bits of frond. Fold the sheet of paper, tip the collected material into the fold, tilt the paper slightly, and tap it gently with a finger or pencil. As the material moves down the fold,

the larger detritus moves forward faster than the spores. The detritus can then be brushed away.

Another method is to sieve the material using very fine mesh sieves of 74 microns (100 to 150 mesh screen) or fabric with fine holes like muslin or cheesecloth.

Disinfecting spores is done with sodium or calcium hypochlorite at 10 grams per 140 milliliters of water. A small quantity of spore is soaked or shaken in a small bottle about two-thirds full of the hypochlorite solution for 5 to 10 minutes. Wash twice with sterile water. Sow using an eyedropper. Spores may also be collected on filter paper, air dried, and stored or applied to the medium.

Tree fern spores germinate best on a rough surface. Many species prefer a near neutral sowing medium (pH 6.5 to 7.5). A proven mixture for sowing is equal parts tree fern fiber, cinder, and peat moss. The medium may be pasteurized by heating at 140 to 160° F for at least 30 minutes.

The spore-dusted medium should be covered with clear plastic or glass and kept free from contamination. A warm, lighted environment is usually best. Direct sunlight will cause damage (Figure 7).



Figure 7. Laboratory methods, such as those used in tissue culture, can be modified to germinate and grow fern spores.

Development of sporelings takes several weeks. First, they germinate to form prothalli, appearing on the surface as green scum. Later, the first true leaves and roots appear. The plants are then known as sporelings. Spores sown in the spring seem to develop much faster than those sown at other times of the year. Development of sporelings is impeded if they are too crowded. Fast-growing species may develop their first leaves within 8 months of sowing. Slow-growing species may take 12 to 18 months before true leaves are formed.

Most tree ferns germinate well at a fairly low light

intensity of 200 to 400 foot-candles, but species of Cyatheaceae, particularly the *Sphaeropteris* group, germinate far better at about 800 foot-candles. Some growers maintain that a period of darkness for 10 to 14 days after sowing is beneficial and promotes more even germination.

Spores germinate best with an increasing day length and a temperature between 70 to 80° F. Fertilize with half-strength liquid fertilizer every 3 to 4 weeks. Use an atomizer when plants are in the prothalli stage.

Initial transplanting is usually in clumps. Use the same sterilized mix and place approximately 1 inch apart in a community tray. Firm medium around each clump after transplanting. Keep misting with sterile water from an atomizer during the transplant process. When the tray is filled, cover with glass or clear plastic film. Prothalli may be transplanted, but the sporeling stage is hardier. When individual, sturdy, little plants develop, remove the glass or plastic and allow plants to harden before the next transplanting. If sufficiently well developed, they may be potted individually into 2-inch liner pots. The smaller, weaker ones should be placed into another community tray. After 6 to 8 weeks, the liners may be transplanted into 1-gallon containers.

CULTIVATION

Tree ferns prefer high rainfall areas, although some species persist well under sunny, drier conditions. Tree ferns are palm-like and convey a tropical appearance when used in the landscape. Surprisingly, certain species will tolerate some frost. Most tree ferns will grow from sea level to 4000 feet in Hawai'i. However, *Dicksonia* species seem to prefer elevations above 1000 feet (Figure 8).



Figure 8. *Dicksonia antarctica* in Kona at an elevation of 3000 feet.

Tree ferns are sensitive to high soluble salts, so organic fertilizers such as fish emulsion and well-rotted manures are commonly applied. Low rates of inorganic fertilizers with a 1:1:1 (nitrogen:phosphorus:potassium) ratio or controlled release fertilizers work well. Soils should be moist, slightly acidic, and high in organic matter.

Many species of palm-like tree ferns are fast growing, thus producing marketable plants in a short time. Initial observations of some Austral-Asian species planted in Kona show a trunk growth rate of 2 to 3 feet per year, compared to 2 to 3 inches of annual growth for native *Cibotium* species.

Commercial propagation of the fast-growing species should increase their availability and provide a wider choice for use by landscapers and homeowners in Hawai'i. Wide use of these tree fern species reduces pressure on native Hawaiian species and help protect fragile Hawaiian forests.

SPECIES

The following discussion of tree fern species occasionally found under cultivation is compiled from various references. Most, except *Cyathea cooperi*, are seldom available in the nursery trade in Hawai'i.

Cibotium chamissoi

This tree fern is called the "Man" fern by Hawaiian islanders. It has a short, stout, fibrous trunk that grows to 15 feet and handsome, massive, tripinnate, glossy, light green fronds. The stipes are covered with blackish, woolly hairs. This fern prefers cool, moist conditions with filtered shade.

Distribution: Hawai'i.

Cibotium glaucum (Figure 9)

This is the "Blonde" or "Female" tree fern of the Hawaiian rain forests. The plants are characterized by stout, fibrous trunks up to 15 or more feet in height, consisting of a mass of aerial roots around a core of starch. The crowns are composed of large, soft-textured, tripinnate, crinkled, luxuriously green fronds. The stipes are covered with soft pale hairs. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Hawai'i.

Cibotium regale

This large, very slow-growing fern gradually forms a stout trunk up to 30 feet in height. The strong, arching, tripinnate fronds grow up to 12 feet long. This fern



Figure 9. *Cibotium splendens* with the stout trunk and, to the right, *Cyathea cooperi* with the slender trunk.

prefers cool, moist conditions with filtered shade.

Distribution: Mexico and Central America.

Cibotium schidei

This is a very slow-growing tree fern with a shapely crown of graceful, light green fronds. These fronds are thin, leathery, and dainty yet durable. The leaves are lacy tripinnate and glaucous beneath. Fronds are from 6 to 10 feet in length. It will eventually, over many years, form a fibrous trunk reaching up to 15 feet high, with matted, brown scales at the base of the fronds. This fern prefers cool, moist conditions with filtered shade.

Distribution: Mountains of Mexico and Guatemala.

Cyathea albifrons

The trunk is 4 to 10 feet high with 5- to 8-foot fronds. This is a striking tree fern with a moderately stout trunk covered with prominent white scales. The undersurface of the frond is conspicuously white, with a waxy luster. Plants are rarely cultivated but have outstanding ornamental features. They are relatively fast growing and like good light with some protection.

Distribution: New Caledonia.

Cyathea affinis

The stipes are short, brown, and covered at the base with lanceolate, chocolate, covered scales. The scales turn prickly further up. The fronds are large, growing to 12 feet long. The leaflets grow up to 24 inches long. Pinnules are 4 to 5 inches long and 1.25 inches wide, with shallow-lobed, lower secondary pinnules. The trunk is often 10 feet or more in height. Sori are borne one below each lobe. This fern prefers cool, moist conditions with filtered shade.

Distribution: A common tree fern in Fiji.

Cyathea arborea (West Indian Tree Fern) (Figure 10)

This is a slender tree fern, 30 to 50 feet high, with a slender, mostly bare, brown trunk, the upper part covered with pale brown scales and crowned by tripinnate, fine-toothed fronds. The fronds are 10 to 15 feet long, soft-textured, fresh green above, paler below, and without spines. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Mountains of Puerto Rico to Jamaica and other high Caribbean islands.



Figure 10. Young *Cyathea arborea* from Puerto Rico, approximately 2 years old.

Cyathea australis (Rough Tree Fern)

The trunk is up to 3 feet thick at the base, thinner above, over 40 feet tall, and thickened into a buttress at the base by masses of wiry, adventitious roots. This is an extremely hardy species that is probably the most common tree fern of southeastern Australia. *C. australis*' range extends from the coast to inland and to an altitude of about 4000 feet. Its habitat range from dark gullies to dry forest fringes and creek banks in open areas. It tolerates sun, particularly if its roots are moist. In sunny situations, the fronds are an attractive light green.

Distribution: Queensland, New South Wales, Victoria, and Tasmania, Australia.

Cyathea baileyana

A very attractive species with a slender trunk up to 5 inches in diameter and up to 15 feet tall. The most notable feature is the curious, wig-like growth which tops the trunk. This growth is bright green when young, but ages to reddish brown. Small off-shoots are produced from underground stolons. This fern prefers cool, moist conditions with filtered shade.

Distribution: Northeastern Queensland, Australia (at altitudes above 1000 feet).

Cyathea brevipinna (alt. *Alsophila brevipinna*)

The trunk is 2 to 5 feet high. It is an unusual tree fern with short, densely crowded fronds, 2 to 3 feet long. The stipe of each frond is very short or almost absent and the basal segments overlap and crowd the center of the trunk. Fronds have a stiff spreading habit. Plants are very slow growing and require bright light, moisture, and protection from strong wind.

Distribution: Lord Howe Island.

Cyathea brownii (Norfolk Island Tree Fern)

The trunk grows up to 60 feet or more in height. This is an extremely robust species similar to *Cyathea cooperi* but with fronds up to 15 feet long and stipes covered with soft, light tan scales. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Norfolk Island.

Cyathea capensis (alt. *Alsophila capensis*) (Cape Tree Fern)

The trunk grows up to 10 feet high with fronds to 8 feet long. It is a hardy tree fern with dark green, somewhat shiny fronds on long dark brown stipes. A mixture of scales and hairs is present on the underside of the fronds. Plants like

shady to semi-shady situations in well-drained soil and plenty of moisture.

Distribution: South Africa.

Cyathea celebica

The trunk grows up to 12 inches in diameter and up to 20 feet tall and is covered with white or yellowish, silky hairs. The fronds are 7 to 10 feet long. This rare species is usually found along streams on the fringe of rain forests. On the Evelyn Tableland, it is found at high altitudes almost in the mist zone, where it grows in an open, grassy habitat. This fern prefers cool, moist conditions with filtered shade.

Distribution: Northeastern Queensland, Australia and New Guinea.

Cyathea cooperi (alt. *Alsophila australis*) (Lacy Tree Fern) (Figure 11)

The trunk grows up to 5 inches in diameter and to 30 feet or more tall, is thickened at the base, and is patterned throughout with large, oval, clean-cut scars left by fallen fronds. This handsome, fast-growing species is popular in cultivation. The apex of the trunk and unfurling croziers are particularly attractive, as they are covered with conspicuous, long, silky, white to brown, scale-like hairs. Specimens from northern Queensland have less persistent hairs. Some extremely robust specimens are occasionally encountered in northeastern Queensland. These closely resemble the Norfolk Island Tree Fern, *Cyathea brownii*. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation. Cultivars include 'Brentwood' and 'Robusta'.

Distribution: Australia.

Cyathea cunninghamii (Slender Tree Fern)

The trunk grows up to 5 inches in diameter and over 70 feet tall. It is slender in young plants but thicker in older plants. This attractive, tall, slender species with a small crown of fronds is restricted to moist fern gullies. It is not common. This fern prefers cool, moist conditions with filtered shade.

Distribution: Southern Queensland, Australia.

Cyathea dealbata (Ponga or Silver King Fern)

This is a noble tree fern with a trunk 10 to 30 feet high. The upper part of the plant is covered with leaf bases and the lower with shiny, brown scales. Large tripinnate fronds spread horizontally from 6 to 12 feet. They are green or yellow-green above and powdery white below. This fern prefers cool, moist conditions



Figure 11. *Cyathea cooperi*, the most commonly available tree fern in Hawaiian nurseries. May be grown from sea level to 4000-foot elevations.

with filtered shade.

Distribution: New Zealand.

Cyathea deckenii

This is a short, straggly tree fern that grows up to 6 feet. The trunk is covered with long, brown fibers. The fronds are on long, rough, hairy petioles. It is occasionally used in the landscape in Puerto Rico. This fern prefers cool, moist conditions with filtered shade.

Distribution: Puerto Rico.

Cyathea dregei

This is a robust tree fern growing up to 15 feet high with a blackish trunk and stiff, erect, smooth, green fronds. This fern prefers cool, moist conditions with filtered shade.

Distribution: In moist forest areas of South Africa.

Cyathea felina

The trunk is up to 25 feet tall, slender, woody, naked, and patterned by scars from fallen stipes. This is a rare

species discovered in 1973 in the monsoonal rain forests on Cape York Peninsula, Australia. It grows near coastal situations, sometimes among the mangroves. This fern tolerates lowland heat and coastal conditions.

Distribution: Northeastern Queensland, Australia, New Guinea, and Malaysia.

Cyathea gigantea (alt. *Alsophila gigantea*)

The trunk is 3 to 15 feet high and the fronds are 6 to 12 feet long. *C. gigantea* is a widely distributed tree fern which has long stipes that are densely covered with shiny, dark brown scales. Fronds are bright green and fairly thinly textured. Plants will tolerate exposure to sun in a sheltered, moist situation.

Distribution: India, China, Sri Lanka, Burma, Thailand, Laos, and Vietnam.

Cyathea glauca (Blue Tree Fern) (Figure 12)

This is a slender tree fern with a trunk up to 50 feet high. It is crowned by fronds up to 12 feet long, bright, glossy green above and bluish gray beneath. The stipes are clothed with white, chaffy scales. The fronds may be slight to heavily armed with spines. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Java, Malaysia, and Assam.

Cyathea hornei

The trunk is 6 feet or more high. The stipes are 16 inches long, slender, dark, with the base covered with rough, lanceolate scales. This fern prefers cool, moist conditions with filtered shade.

Distribution: A common tree fern in Fiji.

Cyathea howeana

The trunk is 3 to 6 feet high and the fronds are 5 to 7 feet long. This delightful tree fern has a spreading crown of soft, lacy, light green fronds atop a slender trunk. On older plants, the new fronds are produced in a spectacular, unfurling flush. The plants resent disturbance and may be somewhat slow to re-establish when transplanted. They like cool, moist conditions in a shady to semi-shady situation.

Distribution: Lord Howe Island.

Cyathea kermadecensis (alt. *Alsophila kermadecensis*)

The trunk is 3 to 10 feet high and the fronds are 3 to 8 feet long. *C. kermadecensis* is a beautiful, but rarely grown tree fern. The plants have a slender, woody trunk with a conspicuous mass of light brown scales over the



Figure 12. Close-up of *Cyathea glauca* showing the armed leaf bases.

croziers and stipes. The crown of fronds is dark green and spreads almost at right angles to the trunk. The plants have proven to be quite fast growing and like strong light, humidity, and plenty of moisture.

Distribution: Kermadec Islands.

Cyathea leichhardtiana (Prickly Tree Fern)

The trunk grows up to 4 inches in diameter and to about 25 feet tall. It is slender and covered with persistent fronds. This is one of the less attractive species, being armed with woody spines. It is found in moist gullies and often in pure stands. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Queensland (as far north as the Eungella Range), New South Wales, and Eastern Victoria, Australia.

Cyathea lepifera (alt. *Sphaeropteris lepifera*) (Flying Spider-monkey Tree Fern)

The trunk is 3 to 10 feet high with fronds 6 to 10 feet

long. A beautiful tree fern which has the apex of the slender trunk covered with white to brown scales. The developing croziers twist slightly and resemble a monkey tail, hence the unusual common name. This is an easily grown species which likes a protected situation and adequate water during dry periods.

Distribution: Taiwan, Philippines, and Japan.

Cyathea loheri (alt. *Alsophila loheri*)

The trunk is 6 to 15 feet high and the fronds are 6 to 10 feet long. It is a large tree fern with prominent, pale-colored, papery scales on the trunk and frond bases. The fronds are lacy, bright green, and spread in a graceful crown. The plants have proven to be somewhat cold sensitive and for best growth require warm, moist conditions.

Distribution: Taiwan, Philippines, and Borneo.

Cyathea lunulata

The trunk grows up to 25 feet high with fronds about 10 feet long. It is the most common tree fern in Fiji. The tree is used in building construction and as pots for ferns and orchids. The scales at the apex of the trunk are used by the Fijians for stuffing pillows and cushions. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Fiji.

Cyathea marcescens (Skirted Tree Fern)

The trunk grows up to 18 inches in diameter and up to 30 feet tall. It is thick, especially at the buttress, and clothed with persistent, hanging, dead fronds. This fern prefers cool, moist conditions with filtered shade.

Distribution: Endemic in Victoria, Australia.

Cyathea medullaris (Black Tree Fern or Mamaku)

This is the tallest of the New Zealand tree ferns. The slender, black trunk grows to 70 feet or more. The base is covered with matted, aerial roots. On top, there is a great crown of spreading, curving, feathery fronds. These fronds are 8 to 20 feet long, firm, deep green above, and paler beneath. The apex and leaf bases are clothed with long, black scales. This fern prefers cool, moist conditions with filtered shade.

Distribution: New Zealand and Southeast Australia.

Cyathea mexicana (alt. *Nephelea mexicana*) (Figure 13)

The trunk is 6 to 20 feet high and the fronds are 6 to 10 feet long. This stout tree fern has a thick trunk which is armed with numerous long, black spines and has a

spreading crown of bright green, lacy fronds. The stipes are also similarly spiny, giving it an unusual horticultural appeal. Plants need warmth, moisture, and bright light to partial sun.

Distribution: Mexico, Central America, and South America.



Figure 13. Young *Cyathea mexicana* grown at Kaloka Mauka, Kona at an elevation of 3000 feet.

Cyathea microlepidota (Balabala)

This tree fern is 6 to 12 feet high with stipes 2 feet long and fronds 5 feet long. This fern prefers cool, moist conditions with filtered shade.

Distribution: Viti Levu and Vanua Levu, Fiji.

Cyathea plaqiastqia

The stipes are 14 inches long, bearing very few scales near the base. The fronds are up to 6 to 7 feet long and about 3 feet wide. The trunk grows to 20 feet. It is a rare plant. This fern prefers cool, moist conditions with filtered shade.

Distribution: Mount Naitaradamu, Fiji.

Cyathea propinqua

The trunk is 6 to 12 feet high, similar to *Cyathea affinis*, but bearing more scales at the base of the fronds. This fern prefers cool, moist conditions with filtered shade.

Distribution: A common tree fern in Fiji.

Cyathea rebecca

The trunk is up to 4 inches in diameter, up to 25 feet tall, very slender, and woody. This is an attractive species closely related to *Cyathea baileyana*, but much more abundant. Offshoots are produced from underground stolons. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with

sufficient irrigation.

Distribution: Northeastern Queensland, Australia (sea level to an altitude of over 4600).

Cyathea robertsiana

The trunk is very slender, woody, smooth, marked by oval leaf scars, up to 5 inches in diameter, and up to 25 feet tall. In old specimens, a large buttress is formed at the base. This unusual tree fern is easily one of Australia's most attractive ferns. The trunk is very thin and woody and is topped by lovely, spreading, soft, pale green fronds. It is unique in Australian tree ferns in that the fronds are not produced in a crown, but are closely spaced up the stem in spirals. Also, with the exception of young, uncoiled fronds, the trunk is devoid of protective scales. In its natural state it is a colonizer, being one of the first to occupy disturbed earth in rain forests. Germination and growth are very rapid for a fern. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Northeastern Queensland (from an altitude of about 1500 feet to about 5000 feet).

Cyathea samoensis

The trunk is 3 to 6 feet high and the leaves are up to 6 feet long. The stipes are slender, black, and covered with small spines towards the base. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Samoa.

Cyathea smithii (alt. *Alsophila smithii*)

The trunk is 6 to 18 feet tall with fronds 6 to 18 feet long. This large tree fern is well suited to temperate districts with a cool, moist climate. Young plants need protection from direct sun but older plants are more tolerant. They like an abundance of moisture, loamy soils, and organic mulch.

Distribution: New Zealand.

Cyathea spinulosa

This is a graceful, small tree fern, growing to 12 feet high, with a slender trunk covered with black-brown fibers and fine, feathered fronds of rich green. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Kuang Tung Province, China.

Cyathea truncata

This is a large tree fern up to 30 feet or more high

with leaves up to 15 feet long. The stipes are dark, fuzzy, and covered with scales. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Fiji.

Cyathea usambarensis

This is a robust tree fern from the Usambara mountains that grows up to 20 feet high. The trunk is approximately 6 inches in diameter and is covered with dark brown fibers. The bipinnate leaves are wide spreading and 10 to 12 feet long. This fern will tolerate full sun in cool, wet areas or filtered shade in warm, dry areas with sufficient irrigation.

Distribution: Tanzania, Africa.

Cyathea vieillardii (alt. *Alsophila vieillardii*)

The trunk grows from 3 to 15 feet high and the fronds from 3 to 6 feet long. This is an attractive tree fern with a slender, dark trunk, warty stipes, and spreading, crowded, dark green fronds. Plants grow easily but need warmth or else the fronds tend to dehydrate. It needs shade to partial sun, well-drained, humus-rich soils, and water during dry periods.

Distribution: New Caledonia, New Hebrides.

Cyathea woolsiana

The trunk grows up to 5 inches in diameter and up to 15 feet tall. It is slender and covered with bristly, spreading, brown or black scales. This beautiful rain forest species is usually found near streams. The fronds have a very pleasant habit and are quite broad for their length. This fern prefers cool, moist conditions with filtered shade.

Distribution: Northeastern Queensland, Australia (usually in mountainous areas).

Dicksonia antarctica (Soft Tree Fern) (Figure 14)

This tree fern has a massive trunk, growing to more than 6 feet in diameter and over 50 feet tall in very old specimens. The trunk is densely covered with brown, fibrous roots and is often buttressed at the base. It is a very common tree fern found in high-rainfall forests and moist gullies. In some Victorian fern gullies it forms huge, pure stands and is an excellent host for a variety of epiphytes, such as filmy ferns, fork ferns, and orchids. The fronds are borne in spectacular flushes, with the large, broad specimens unrolling up to forty at a time. Aboriginal people ate the pith from the center of the trunk. This fern prefers cool, moist conditions with filtered shade.

Distribution: South Australia, Tasmania, and New Zealand.



Figure 14. *Dicksonia antarctica*.

Dicksonia brackenridgei

The trunk is 3 to 10 feet tall and the fronds are 5 to 8 feet long. This species is hardly known in cultivation. However, those plants which have been introduced grow easily. In nature, plants occur in moist rainforests, sometimes in colonies. The slender trunk is covered with long, reddish hairs and the fronds are finely lobed and coarse textured. They require a moist, sheltered situation.

Distribution: Fiji and Samoa.

Dicksonia fibrosa (Golden Tree Fern)

This tree fern has a stout trunk growing up to 20 feet high and covered with brown, fibrous, aerial rootlets. It has large, fresh green fronds up to 8 feet long that are fairly stiff. This fern prefers cool, moist conditions with filtered shade.

Distribution: New Zealand.

Dicksonia herbertii

The trunk is 3 to 10 feet high and the fronds are 5 to 8 feet long. It is a species found in highland rainforests, often growing in wet soil. Young parts are covered with coarse, brownish, prickly hairs. This can be a fairly fast-growing species preferring light shade and an abundance of water.

Distribution: Australia.

Dicksonia mollis

The trunk is 3 to 10 feet high with fronds 6 to 10 feet long. It is a slender tree fern of highland rain forests where it may grow in exposed situations. Frond bases are covered with reddish, shiny hairs. This species is not generally cultivated but can be grown in moist, protected conditions

in good light.

Distribution: Malaysia, Philippines, and Indonesia.

Dicksonia sellowiana

The trunk is 3 to 10 feet tall and the fronds are 2 to 3 feet long. This is an attractive species with a slender trunk. The apex and bases of the stipes are covered with conspicuous, yellow hairs. The fronds are dark green, fairly narrow, and firm textured. The plants have proven to be very adaptable in cultivation, preferring shady, moist conditions.

Distribution: Mexico, Central America, and South America.

Dicksonia squarrosa (Figure 15)

This is a medium-sized tree fern, growing up to 20 feet high, with a slender, black trunk clothed with leaf bases. The crown has fronds which are nearly horizontal, growing to 8 feet long, and are dull, dark green in color. They are stiff, leathery, and harsh to the touch. The fronds are on black-brown stalks which are clothed by long, brown, stiff hairs when young. This fern prefers cool, moist conditions with filtered shade.

Distribution: New Zealand.



Figure 15. *Dicksonia squarrosa*.

Dicksonia youngiae (Bristly Tree Fern)

This is a particularly attractive species. The trunk is slender, up to 8 inches in diameter and up to 15 feet tall. It is dark and fibrous. The upper trunk and stipes are covered with course, stiff, reddish bristles. The species is rare and is confined to rain forests, usually at high altitudes. This fern prefers cool, moist conditions with filtered shade.

Distribution: Queensland (as far north as the Atherton Tableland) and northeastern New South Wales, Australia.

GLOSSARY

aerial roots. Adventitious roots arising on a rootstock and growing in the air, e.g., on the trunks of tree ferns.

apex. The tip or distal end of an organ.

arborescent. With a tree-like growth habit.

bipinnate. Twice pinnately divided.

caudex. The trunk of a tree fern.

crozier. The coiled, young frond of a fern; the fiddlehead.

glaucous. With a distinct, waxy bloom which gives a bluish appearance.

indusium. Protective outgrowth of leaf tissue covering or partially covering the sorus, at least when young.

lanceolate. Lance-shaped; several times longer than wide, tapering slowly to the apex and rapidly to the base.

petiole. The stalk of a leaf; in ferns, a stipe.

pinnate. Once divided with the divisions extending to the rachis.

pinnatifid. Once divided with the divisions extending about one-quarter to one-half way to the rachis.

pinnule. A secondary pinna; the ultimate segment of a frond divided two or more times.

prostrate. Lying flat on the ground.

prothallus. A thinly textured, flat growth resulting from the germination of a spore and bearing archegonia and antheridia.

sorus. A group or arrangement of sporangia in ferns.

sporangium. A spore case.

spore. A vegetative reproductive unit that does not contain an embryo and is found in cryptogams.

stipe. The petiole of a fern or palm frond; a stalk.

stipules. Bract-like appendages borne in pairs at the base of a petiole.

tripinnate. Three times pinnate or divided.

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