

# *Ficus microcarpa*

Chinese banyan

Moraceae

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January, 2003

## OVERVIEW

*Ficus microcarpa* is a popular ornamental tree grown widely in many tropical regions of the world. The pollinator wasp has been introduced to a number of places where the tree is cultivated, including Hawai'i, allowing this species to spread beyond initial plantings. *F. microcarpa* is a notorious invader in Hawai'i, Florida, Bermuda, and from Central to South America. Tiny seeds within small sized fruit are ingested by many fruit eating animals, such as birds. Seeds are capable of germinating and growing almost anywhere they land, even in cracks in concrete or in the crotch of other trees. The small seedling begins to grow on its host, sending down aerial roots, and eventually strangling and replacing the host tree or structure. In Hawai'i, most of the main islands are infested with *F. microcarpa*. Typically, this species invades disturbed urban sites to degraded secondary forests in areas nearby initial plantings. It has recently been observed growing on native wiliwili (*Erythrina sandwicense*) in lowland dry forests of Maui. On the main islands of Hawai'i, rapid containment once inside natural area boundaries may be the only feasible action, given the widespread distribution. On Midway Atoll, the wasp was introduced later than on the main islands and, as a result, *F. microcarpa* has only recently begun to spread there. With limited distribution, control here seems more feasible than on the main islands. To decrease the potential for this species to spread, it should not be introduced to new areas and could be removed in natural areas where it is limited in distribution.

## TAXONOMY

**Family:** Moraceae (Mulberry family)

**Latin name:** *Ficus microcarpa* L. fil. (Wagner et al. 1999).

**Synonyms:** *F. nitida* sensu auct., non Thunb.; *F. retusa* sensu auct., non L. (Wagner et al. 1999). *Urostigma microcarpum* (L. f.) Miq; *F. retusifomis* H. Lev. (Missouri Botanical Garden 2002). *F. thonningii* Blume (PLANTS 2001).

**Common names:** Chinese or Malayan banyan (Wagner et al. 1999). Indian Laurel (Bailey and Bailey 1976). Curtain fig (Brickell and Zuk 1997).

**Taxonomic notes:** The genus *Ficus* is made up of about 1,000 species from pantropical and subtropical origins (Wagner et al. 1999). Plants in the genus are all woody, ranging from trees and shrubs to climbers (Neal 1948).

**Nomenclature:** The species name, *microcarpa*, refers to the small size of the fruit.

**Related species in Hawai'i:** In Hawai'i, about 60 other species of *Ficus* are cultivated (Wagner et al. 1999).

## DESCRIPTION

"Variable in habit, often epiphytic, subsucculent shrubs when young, in maturity spreading evergreen trees with large branches and numerous aerial roots hanging from the trunk and branches, these sometimes reaching the soil to form pillar-like roots. Leaves variable, coriaceous, oblong, elliptic to broadly elliptic or obovate, usually 5-8 cm long, 3-5 cm wide, glabrous, margins entire, petioles 0.6-2 cm long. Syconia sessile, arising among or just below the leaves, depressed-globose, 6-10 mm in diameter, subtended by 3 broadly ovate, persistent bracts." (Wagner et al. 1999). Seeds minute, less than 1 mm (pers obs.).

## BIOLOGY & ECOLOGY

**Cultivation:** A widely cultivated tree throughout the world. Riffle (1998) notes that *F. microcarpa* is one of the most common street trees in warm climates around the world. This is true in Hawai'i, where *F. microcarpa* is described by Neal (1965) as one of the more common *Ficus* trees planted throughout the state. It has been grown in gardens of Hawai'i since the early 1900's and is now naturalized probably on all the main islands (Wagner et al. 1999).

**Invasiveness:** *F. microcarpa* has become a well known invader due to several characteristics that allows it to successfully establish and spread. Some of these characteristics include the following: popularity in the horticulture industry and ability to get around the globe in large numbers, intentional and unintentional introduction of pollinator wasps, large fruit production, dispersal agents such as birds, bats, rodents, and others, and ability to grow in inhospitable places with little requirements. In addition to these characteristics, which are typical of many invading *Ficus* spp., *F. microcarpa* has the added ability to disperse more often due to its small fruit size which allows the fruit to be taken by a larger number of dispersal agents. In addition, Bronstein (1989) proposes that *F. microcarpa* has the ability to establish with a smaller population size due to its "asynchronous" fruiting cycle which allows wasps to find fruits of all life stages throughout the year.

**Pollination:** The fruit (syconium or fig) and reproduction systems of species in the genus *Ficus* are unique. Each species of *Ficus* has an associated species of agaonid wasp (Hymenoptera: Chalcoidea: Agaonidae). *Ficus* species can only be pollinated by their associated agaonid wasps and in turn, the wasps can only lay eggs within their associated *Ficus* fruit. For successful pollination and reproduction of *Ficus* species to occur, its associated pollinator wasp must be present. Conversely, for successful reproduction of agaonid wasps to occur, their associated *Ficus* species must be present (Janzen 1979). The pollinator wasp for *F. microcarpa*, *Parapristina verticillata*, was purposefully introduced to Hawai'i in 1938 (Wagner et al. 1999).

**Propagation:** In Hawai'i, seeds are readily germinated. It can also be grown from cuttings and air layers (Dehgan 1998).

**Dispersal:** Plants are spread over long distances through the horticulture industry. In Central America, fruits of *F. microcarpa* are dispersed by both bats and birds anywhere

that *F. microcarpa* produces mature fruits (McKey 1989). In Hawai'i, various birds observed by the authors foraging and roosting in *Ficus* spp. trees on Maui include mynah birds (*Acridotheres tristis tristis*), blue faced doves (*Geopelia striata*), lace necked doves (*Streptopelia chinensis*), Japanese white-eye (*Zosterops japonicus*), Northern cardinals (*Cardinalis cardinalis*), and house sparrows (*Passer domesticus*), though there are probably more. Other animals, such as bats, pigs, rodents, parrots, and monkeys may be capable of spreading fruit. In Florida, the seeds of *F. microcarpa* are also dispersed by ants attracted to an oily tissue coating the seed (Nadel et al. 1991.)

**Pests and Diseases:** In Hawai'i, there are a number of insects which attack *F. microcarpa*. The Cuban laurel thrip (*Gynaikothrips ficorum*) causes visible damage to leaves (Smith 1998). It was first documented from the State in 1964 (DOA 2002). One year later, in 1965, *Macrocentrus thripiformis* (Hemiptera: Anthocoridae) was introduced from Mexico as a biological control agent for the Cuban Laurel thrips (Teramoto and Heu 2000). Another insect that causes visible leaf damage is the banyan leaf gall wasp (*Josephiella* sp.). It was first found in the State in 1989 (DOA 2002). Another wasp which attacks the fruit of *F. microcarpa* is the Torymid wasp (*Sycophila* sp.) which was first found in the State in 1976 (DOA 2002).

## **DISTRIBUTION**

**Native range:** *F. microcarpa* is native from Ceylon to India, southern China, Ryukyu Islands, Australia, and New Caledonia (Wagner et al. 1999). In its native range, southern Asia, *F. microcarpa* thrives in moist regions, where it is common up to 6,000 ft (1,829 m) (Neal 1965).

**Global distribution:** *F. microcarpa* is established in at least Hawai'i, Florida, Bermuda, and from Mexico to South America. In Florida, *F. microcarpa* was widely planted as an ornamental and began to spread once its pollinator arrived. Apparently, the wasp was an unintentional introduction that perhaps arrived live in fruit transported from other infested areas, though this is not certain (McKey 1989). Currently, this species invades urban and suburban areas, however, it is predicted that this weedy species will become a future invader of natural areas. The Missouri Botanical Garden's specimen database (2002) lists the following location for North America: USA, Florida, Dade, 5 m (16 ft), 25.41N 80.16W, collected on March 9, 1992.

In Bermuda, *F. microcarpa* was heavily planted in the 1940's to 1950's. Pollinator wasps and seedlings first appeared around 1980 (McKey 1989). It is uncertain how the wasp arrived, though it is suspected to have arrived in fruit from elsewhere. Control methods are currently being explored.

The pollinator wasp and seedlings of *F. microcarpa* were first observed in Mexico around 1985 (McKey 1989). Fruit is dispersed by bats and birds and is a potential threat to tropical forests there. The following locations from Mesoamerica are listed in the Missouri Botanical Garden's specimen database: El Salvador, San Salvador, 710 m (2,329 ft), 13.47N 89.11W, collected on December 17, 1971; Honduras, Francisco Morazan, 14.15N 87.10W, collected on October 17, 1978; Mexico, Campeche, Chiapas,

and Quintana, collected on March 28, 1982, May 12, 1982, and June 8, 1984, respectively; Nicaragua, multiple collections, ranging from 40 m (131 ft) to 830 m (2,723 ft), 11.28N 85.31W to 13.10N 86.20W, collections made from 1979 through 1984; and Panama, Darien, 8.13N 77.54W, collected on July 1, 1959.

In South America, the following locations are listed in the Missouri Botanical Garden's specimen database: Bolivia, Beni; Columbia, Valle del Cuaca, 1,000 m (3,280 ft), collected on February 2, 1984; Ecuador, Guayas, Capeira, 20-200 m (66-656 ft), 02.00S 79.58W, collected on September 26, 1981; and Venezuela, Aragua, Maracay, collected on July 21, 1985.

Asian specimens listed by the Missouri Botanical Garden's specimen database include the following locations: India, Tamil Nadu, 1000 m (3,280 ft), 11.36N 76.32 E, collected on June 10, 1989; Lesser Sunda Island, Bali, 8.15S 115.25E, collected on June 16, 1976; Taiwan, 200 m (656 ft), 21.55N 120.50E, collected on July 31, 1989.

*F. microcarpa* is cultivated in some places where the pollinator wasp has not yet been introduced. In New Zealand, for example, this species is occasionally cultivated and seems to stay where it is planted because the wasp has not yet arrived. It is considered a weed to watch because of its potential to become a pest should the pollinator arrive (Owen 1996).

Oceania specimens listed from the Missouri Botanical Garden's specimen database include: New Caledonia, 22.11S 166.32E, collected on August 8, 1979. In the Pacific, *F. microcarpa* is also known from the Commonwealth of the Northern Mariana Islands (Saipan, Pagan, Alamagan, Tinian, and Rota), Federated States of Micronesia (Chuuk, Yap, and Kosrae), French Polynesia, Guam, Marshall Islands, Palau, and Tonga (PIER 2002). It is also known from Christmas Island (PIER 2002).

**State of Hawai'i distribution:** Wagner et al. (1990) reported the naturalized distribution of *F. microcarpa* in Hawai'i from O'ahu, Maui, and Hawai'i, but probably all of the main islands. Since then, it has also been reported from Moloka'i (Hughes 1995), Kaua'i (Lorence et al. 1995), and Midway Atoll (Starr et al. 2002). At Midway Atoll, the pollinator wasp was not noted by Nishida (1998), though it must be present because several large mature *F. microcarpa* are producing seedlings and spreading on Sand Island. Many of these seedlings are small juvenile trees, suggesting that the wasp is a somewhat recent arrival, perhaps within the past few decades. On Midway, mynah birds (*Acridotheres tristis tristis*) are the most likely dispersal agents of seeds of *F. microcarpa*.

Smith (1998) reports the following: "This species grows in all but the wettest and driest habitats on all of the major islands, most commonly on cliffs and rocky outcrops. It has the potential to grow up to 1,500 m (4,921 ft) but rarely grows much above 700 m (2,297 ft). There are some particularly large trees along the Hana coastline, Maui."

Little and Skolmen (1989) report the following notes on *F. microcarpa* in Hawai'i: "This is a common species of the genus grown as an ornamental in lowlands of Hawai'i. It has escaped from cultivation and can be found occasionally in the forest. Near homes, it seeds prolifically in drain pipes and gutters where small deposits of silt permit rooting. Actually, only 469 trees of this species are reported as having been planted in the Forest Reserves."

**Island of Maui distribution:** On Maui, *F. microcarpa* is widely cultivated and is one of the most common trees observed in landscaping. Both cultivated and naturalized plants are abundant in most areas where human activity occurs (near houses, buildings, and gardens) from sea level up to 3,500 ft (1,067 m). The only areas free of this species seem to areas far from cultivated plants, such as the top of the mountains and large tracts of agricultural or pastoral land. Plants readily germinate on other trees, on bridges, on buildings, and other structures. Eventually, the tree engulfs its host. Natural areas (both wet and dry forests) near cultivated and naturalized plants are threatened by invasion of *F. microcarpa*. In addition, the water delivery system that brings surface water from the slopes of East Maui is also threatened by damage caused by *F. microcarpa* which take root on and break up the concrete ditches.

## **CONTROL METHODS**

**Physical control:** Small seedlings could be hand pulled, though these are likely to grow back if not completely removed.

**Chemical control:** "Fig trees are particularly sensitive to triclopyr herbicides as a basal or cut-stump treatment. Trees found growing on concrete or rock structures should be treated with herbicide while young to avoid costly structural damage. Use extreme caution when applying herbicide to figs growing as epiphytes to ensure that the poison does not contact the host tree. When exotic figs germinate high in the branches of large trees in natural forest communities, it may be extraordinarily difficult to get close enough to the fig to treat it." (Hammer 1996).

**Biological control:** Nadel et al. (1991) report several pests that could be looked at for biological control potential including various ants which were seen carrying off pollinator wasps from *Ficus* fruits, Hymenoptera and mites that may be parasites of the pollinator wasps, and staphylinids which were seen entering *Ficus* fruits and eating the pollinator wasps.

**Cultural control:** To prevent the spread of this species, especially in areas where it does not yet occur, do not plant this species. Use native or non harmful non-natives as alternative plants. *F. benjamina* could be used instead of *F. microcarpa*, as it is very similar in appearance, but does not yet show signs of spreading because it does not have its pollinator wasp present.

**Noxious weed acts:** None. Listed as a category I species in the Florida Exotic Pest Plant Council (FLEPPC 1997) list of Florida's most invasive species. Category I species are: "species that are invading and disrupting native plant communities in Florida."

## MANAGEMENT RECOMMENDATIONS

*F. microcarpa* is widely planted throughout the world as a specimen or shade tree. The pollinator wasp has been introduced both intentionally to places such as Hawai'i and unintentionally to other places such as Florida. The presence of pollinator wasps allows *F. microcarpa* to produce viable seeds and spread from initial plantings. Fruits of this species are small and are eaten by numerous fruit eating birds and possibly other animals. Seeds are then deposited in trees or other structures. The seedling grows as an epiphyte eventually engulfing its host. This species is capable of growing in a variety of conditions from wet to dry and at different elevations from sea level to several thousand feet. As urban areas are built closer to natural areas, *F. microcarpa* will continually increase as a threat to native trees. It has also proven to be a nuisance to water delivery systems in East Maui. The distribution on Maui is extremely widespread and eradication at this point is not an option. In natural areas where *F. microcarpa* is just beginning to invade, it should be controlled as soon as possible to prevent a major infestation. Islands or nations free of *F. microcarpa* should not introduce this species, given its invasive track record to date. The pollinator wasps for other *Ficus* species that are not yet present in Hawai'i should be placed on the Department of Agriculture's injurious species list and banned from introduction to prevent future invasions by other *Ficus* species.

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