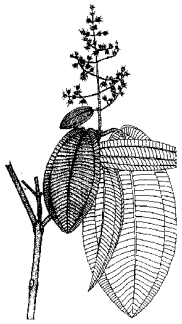
Miconia calvescens DC.

Miconia calvescens, in the melastome family (Melastomataceae), is a tree 4-15 m tall with large (to 80 cm in length), strongly trinerved leaves, dark-green above and purple below.

Federal Noxious Weed?	N	Hawaii State Noxious Weed?	Y
Federal Seed Act?	N	Hawaii State Seed Act?	N



[illustration source: unknown]

Native to where :

The native range of Miconia calvescens extends from 20 degrees N in Mexico, Guatemala, and Belize to 20 degrees S in Brazil and Argentina (Meyer 1994).

The upper elevational limit of the species in its native range is 1830 m in Ecuador (Wurdack 1980). Meyer (1994) determined that the form with very large leaves with purple leaf undersides occurs only in Mexico, Guatemala, Belize, and Costa Rica; specimens examined by Meyer were collected at elevations between 45 m and 1400 m.

Native climate :

The climate in which *Miconia calvescens* occurs is tropical montane. Based on its ecology in Tahiti and its occurrence to 1830 m in Ecuador, it appears to pose a threat to all habitats below the upper forest line which receive 1800-2000 mm (75-80 inches) or more of annual precipitation.

Biology and ecology :

Phenology: Flowering and fruiting of mature trees in Miconia calvescens populations in Hawaii appear to be somewhat synchronized and may be triggered by weather events (drought and/or rain). A single tree can flower/fruit 2-3 times in a year. A single flowering/fruiting event is prolonged, and all stages and mature and immature fruits are often seen on a single tree.

Reproductive cycle: Flowering and fruiting occur in Miconia trees above about 3-4 m in height and at least 4-5 years old. Full-sized (> 8 m) trees produce 50-200+ inflorescences, increasing with tree size and sun exposure. Each inflorescence is comprised of 1000-3000 white-pinkish, perfect flowers with exserted styles. When open, the short-lived (ca. 12-24 hrs) flowers are strongly sweet-scented. At Hana, Maui, introduced syrphid and other unidentified small flies have been observed visiting flowers.

Ripe fruits are dark purple, average 6mm (1/4 inch) in diameter and have a sweet taste; each fruit contains 50-200 seeds; seeds are tiny, about 0.5 mm (1/50 inch) in diameter. A single "typical" 10 m tree with 100 inflorescences, 300 fruits/inflorescence, and 100 seeds per fruit, will produce 3 million seeds, perhaps two or three times a year, resulting in huge soil seed bank and tremendous potential for dispersal by birds.

Seed Dispersal: The fruits of Miconia calvescens are eaten by, and the seeds dispersed by, non-native frugivorous birds. In the Society Islands, Miconia seeds are dispersed by the abundant silvereye (Zosterops lateralis) (Gaubert 1992), and the red-vented bulbul (Pycnonotus cafer) (Meyer 1996). In Hawaii, dispersal is presumably by Japanese white-eye (Zosterops japonicus), common mynah (Acridotheres tristis), the red-billed leiothrix (Leiothrix lutea) and perhaps northern cardinal (Cardinalis cardinalis). In Hawaii, the Japanese white-eye is abundant from low elevations up to high elevation native rain forests. The red-vented bulbul, an important disperser of Miconia seeds in the Society Islands, is present on Oahu but absent on the other islands as of February 1997.

Seed Banks: Over time, soil beneath dense naturalized stands accumulate prodigious quantities of Miconia seeds. In greenhouse trials in Tahiti, a square meter of the top 2 cm of soil from a dense Miconia stand, periodically disturbed, produced 17,808 M. calvescens seedlings in six months (Gaubert 1992).

Data from Maui suggest that these seed banks lie largely dormant under normal shaded

conditions but are stimulated by the opening of the canopy. After herbicidal defoliation of Maui's main population, Miconia seedlings appeared in great numbers, especially on preferred microsites of mineral soil, dead tree boles, and dead Sadleria tree fern trunks. Under normal conditions on Maui, Miconia seedlings are characteristically found clustered or scattered near, or less often at some distance from, fruiting-sized Miconia trees, sometimes in deep shade.

Meyer (1994) has verified Miconia calvescens seed life in soil samples of more than two years. Three years after acquisition, Maui horticulturists have found Miconia germinants in pots of Heliconia from Miconia-infested Helani Gardens. Indirect evidence from a long-term plot on Raiatea, Society Islands suggests seed life of at least four years (J.-Y. Meyer, unpublished).

Natural Enemies: Herbivory by the Chinese rose beetle (Adoretus sinicus) on M. calvescens leaves is frequently observed in both the Hawaiian and Society Islands. Though this herbivory can cause up to 50% defoliation on individual leaves, it has never been widespread and has not been observed to cause tree mortality.

Value to humans : Horticultural

Miconia calvescens is an attractive plant and a botanical curiosity; it has been cultivated in greenhouses in Europe since the 1850s. Because of its attractive purple and green foliage, it was introduced to Hawaii as an ornamental in the 1960s. It was sold by several nurseries, including Hirose Nursery in Hilo, prior to the listing of Miconia as a noxious weed in 1992.

Problems : *Miconia calvescens* has become widespread and overwhelmingly dominant on Tahiti, an island with rain forest habitat very similar to that of the Hawaiian Islands and other high islands of the Pacific. First introduced to Tahiti at the Papeari Botanical Garden in 1937, it now occurs over 65% of the 1045 km2 island and occurs as dense, monospecific stands over 25% of the island (Meyer 1996). Ecosytems become completely transformed as M. calvescens gains dominance, due to its creation of deep shade which no native species can tolerate (Meyer 1996). In Tahiti, 70-100 native plant species, including 35-45 species endemic to French Polynesia, are directly threatened by invasion of M. calvescens into native forests (Meyer and Florence, unpublished ms.). This invader has now spread to three other islands of French Polynesia. It is also naturalized to a lesser extent in Sri Lanka and Jamaica (Meyer 1996).

Miconia calvescens deserves its reputation as the most invasive and damaging of alien plant species to wet forests of Pacific islands. In its native range, this species is characteristic of the forest understory and is an invader of light gaps. This Miconia species has become widespread and overwhelmingly dominant on Tahiti, an island with rain forest habitat very similar to that of Maui. Now that it is in Hawaii, it ultimately poses a threat to all habitats receiving 1800-2000 mm (75-80 inches) or more of annual precipitation.

Control strategies : VARIOUS (SEE NOTES)

The island of Maui is where efforts in the Hawaiian Islands were first mobilized against Miconia calvescens. National Park Service biologists became aware in 1990 that Miconia was present on Maui, and an alarm was raised (Gagne et al. 1992), about 20 years after its apparent introduction at Helani Gardens near Hana in northeastern East Maui. Seven populations were found in the general vicinity, but prospects seemed good for eradication because all were easily accessible. Over 20,000 plants were removed in 1991-93 with assistance of volunteers. However, a much larger concentration of Miconia, discovered by a Maui state forester in September 1993, occurs in several foci within a 150 ha area on a 500-year-old lava flow upslope (100-350 m elevation) and west of the original introduction site. By the time of its discovery, it contained an estimated 1000 fruiting trees (R. Hobdy and A.C. Medeiros, pers. obs.). A multiagency effort at eradication has been mobilized by the Melastome Action Committee and the East Maui Watershed Partnership, both of which include representatives from federal, state, county, and private entities.

Containment vs. Eradication: In formulation of strategies for combatting Miconia in Hawaii, it has been difficult to settle on the term for the goal to be achieved -- whether it is eradication or containment. Because of the life history characteristics of M. calvescens, with 4-5 years and

3-4 m of height growth separating seedlings from fruiting trees, eradication is clearly possible for some small localized populations and may be possible for entire islands. Working against eradication is the longevity of the seed bank (4+ years, and not fully assessed); eradication will clearly require sustained commitment, but so will containment. Some participants working at the statewide level have advocated referring to the statewide effort as a containment program (R.A. Holt, pers. comm.). Others advocate aiming for eradication at a locality or island level, with the realization that it may be only an ideal. Unfortunately, as long as there is a seed source of Miconia in the state, there will always be a strong possibility of infecting new areas or reinfecting infecting areas from which the plant has been eradicated.

Removal of Miconia by Ground Crews and Volunteers: Hand removal (uprooting) is an effective method of removing plants less than about 3 m tall. Adventitious rooting of uprooted individual occurs occasionally but is rare. If larger Miconia cannot be uprooted and are cut down, the stump must be treated with an herbicide (e.g. Roundup, Garlon 4) or it will resprout. Garlon 4 has been shown to be highly effective for this purpose in tests conducted by The Nature Conservancy of Hawaii (TNC) and the National Park Service.

In large Miconia concentrations, canopy removal often results in a spectacular germination of the Miconia seed bank. Substantial areas in clearings may be covered by Miconia seedlings. About 18 months after germination, there can be up to 500-1000 seedlings/m2, with the tallest about 0.7 m tall. These can effectively be dealt with by spraying with Garlon 3A. A second (and 3rd?) treatment will be required after another 1-2 years to destroy the remaining seed bank (although seedling numbers in subsequent generations are reduced).

Aerial Spraying: The largest Miconia population on Maui, discovered from the air in 1993, was initially virtually inaccessible on the ground because of the extremely rough terrain of a 500-year-old lava flow. As a holding action to limit seed production, a Hughes 500-D helicopter with an attached unit spot-sprayed herbicide on larger, fruiting Miconia trees beginning in early 1994. This specific-delivery spot-spray system had been developed to control illegal marijuana cultivation in remote mountain areas. The herbicide (Garlon 4, ester formulation of triclopyr) was applied with surfactant and blue dye (Turfmark). The dye assists the pilot in judging application rate and identifying treated plants. This program has implemented by HDLNR, with technical assistance HDOA. NBS researchers conducted monitoring to assess effects of the spraying. In the initial trials, about 70% of sprayed individuals were killed; others lost leaves and aborted flowers and green fruits, yet recovered and fruited in the next fruiting season (A. Medeiros, unpublished data.).

Access Roads: The greatest problem for on-the-ground control and monitoring of largest Miconia population of Maui is one of access. The terrain is extremely rough on the 500-yr-old lava flow, making walking very difficult, even on a cleared path. Traversing 100 yards in some areas through a vegetation cover can take more than an hour. An old, partially overgrown bulldozer track proved the best access route initially. Five miles of new access routes were opened by bulldozing in 1996-97 to allow crews to reach control sites rapidly and safely. Work was done by contract, at a cost of $7,000-10,000 per mile.

Prevention of Spread of Miconia Seeds in Mud on Boots, by Bulldozers, etc.: An important factor in mechanical and chemical control is the seed bank associated with Miconia stands which necessitates monitoring and removal of emergent seedlings for 5-10 years. Another problem is the potential transfer to other sites of Miconia seeds in soil on the boots and equipment of crews engaged in assessment and control efforts. This problem was dramatized in an incidient experienced by the NBS Research program on Maui: after a seedling of Miconia calvescens was found in a rain forest vegetation plot several miles distant from the nearest known population, it was clear that the seed was dispersed by a researcher using gear worn at both sites, even though gear was cleaned by hand-washing between uses. After this incident, those working with Miconia are encouraged to wear conspicuously-marked footwear and other gear which are "dedicated," i.e. used only for work involving Miconia.

The seed dispersal problem greatly complicates the issue of using volunteers. Whenever Miconia control is undertaken, a supervisor must be responsible for seeing that safeguards are

taken seriously. Whenever bulldozers and other vehicles are used in Miconia areas, they must be pressure washed immediately afterwards.

Education: Public education has been a crucial aspect of Miconia containment/eradication and has been aided by the distinctiveness of the plant, with its huge leaves with purple undersides. Major articles on Miconia first appeared in The Maui News and the Honolulu Star-Bulletin in May-June 1991. A colorful and factual "wanted" poster on Miconia was prepared and produced large numbers. Since it became available in late 1991, this poster has been distributed widely to educate people and solicit reports of Miconia locations. In April 1993, Jean-Yves Meyer, a French graduate student conducting studies on Miconia in Tahiti, visited Hawaii, was shown Miconia populations on Maui and Hawaii, and made contacts with numerous agencies and individuals. In June 1994, Arthur Medeiros of NBS was sent to Tahiti and, assisted by Meyer, obtained good photographic documentation of the Miconia situation in Tahiti and French Polynesia. This photographic documentation of potential damage by Miconia has proved invaluable in convincing doubters of the need for prompt action. Dr. Meyer completed his Ph.D. thesis on Miconia in early 1995 and now works in Tahiti for the Ministry for the Environment; he presented a keynote talk on Miconia at the 1995 Hawaii Conservation Conference in July. Medeiros has made numerous presentations based on his Tahiti visit. In October-November 1995, stories on Miconia appeared in The Boston Globe and in U.S. News and World Report (Carpenter 1995; Kong 1995). A public service announcement on the threat from Miconia was prepared under the direction of the MAC. It is shown repeatedly by several TV stations; it led to the a crucial first report of Miconia from the island of Kauai.

Biological Control: An important prospect for long-term control of Miconia calvescens in areas wherever it is invasive is classical biological control. The Hawaii Department of Agriculture began efforts to pursue this option in mid-1993. Exploratory entomologist Robert Burkhart visited Costa Rica, Brazil, Uruguay, Paraguay, Argentina, Trinidad and Tobago. Over 70 species of potential biological control agents were found, including fungi, weevils, leaf beetles, and numerous species of butterflies and moths.Success of biological control of invasive plants has had mixed results. Chances may be enhanced by the fact that the Hawaiian flora lacks native melastome species; opportunities for bringing in generalist melastome feeders may considerably enhance the chances for success against Miconia. But even assuming best case scenarios for Miconia biocontrol, success is probably at least a decade in the future.
At the end of 1996, a proposal for release of the fungal agent Collectotrichium gloeosporoides f. sp. miconiae was submitted to the Hawaii Department of Agriculture.

Local history : Through perusal of botanical garden records and discussions with knowledgeable horticulturists, it has been determined that Miconia calvescens was present in the Hawaiian Islands on Oahu (a single tree in Wahiawa Botanical Garden) by 1961. It had reached Hawaii island by 1964 at the latest, and Maui by the late 1960s or early 1970s. It may have reached Kauai by the early 1980s, based on its recent (1995) discovery there of a fruiting tree over 10 m tall. (See Medeiros et al. 1997 for details.)

Invasive attributes : *Miconia calvescens* is able to germinate and persist at very low light levels. Able to respond dramatically to slight canopy opening and to overtop and shade out its competitors. Abundant seed production, with seeds dispersed by birds and mammals (including mud on boots of humans).

Invaded ecosystem attribs : Based on its ecology in Tahiti and its occurrence to 1830 m in Ecuador, *Miconia calvescens* appears to pose a threat to all habitats below the upper forest line which receive 1800-2000 mm (75-80 inches) or more of annual precipitation (although whether it can invade in the Hawaiian Islands above ca. 1200 m elevation remains to be seen). Seedlings are able to survive at very low light levels, but slight canopy openings allow much accelerated growth.

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Relevant websites :

http://www2.hawaii.edu/~halesci/MiconiaInHawaii/ (an up-to-date compendium of all known websites RE: *Miconia calvescens*, particularly with respect to its being an invasive weed)
http://www2.hawaii.edu/~halesci/hnis/index.html#MicCal (species info & control methods summary)
http://www2.hawaii.edu/~halesci/AlienSpeciesInHawaii/AlienPlantDistributionMapsBySpecies.htm#MicCal (current distribution maps of Miconia calvescens in Hawaii)

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