Family: ***Myricaceae***

Taxon: ***Morella faya***

Synonym: *Myrica faya Aiton (basionym)*

Common Name: fayatree
firetree
candleberry myrtle

Questionaire : current 20090513 **Assessor:** Chuck Chimera **Designation:** H(HPWRA)
Status: Assessor Approved **Data Entry Person:** HPWRA OrgData **WRA Score 17**

101	**Is the species highly domesticated?**	**y=-3, n=0**	**n**
102	**Has the species become naturalized where grown?**	**y=1, n=-1**	
103	**Does the species have weedy races?**	**y=1, n=-1**	
201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**(0-low; 1-intermediate; 2-high) (See Appendix 2)**	**High**
202	**Quality of climate match data**	**(0-low; 1-intermediate; 2-high) (See Appendix 2)**	**High**
203	**Broad climate suitability (environmental versatility)**	**y=1, n=0**	**y**
204	**Native or naturalized in regions with tropical or subtropical climates**	**y=1, n=0**	**y**
205	**Does the species have a history of repeated introductions outside its natural range?**	**y=-2, ?=-1, n=0**	**y**
301	**Naturalized beyond native range**	**y = 1*multiplier (see Appendix 2), n= question 205**	**y**
302	**Garden/amenity/disturbance weed**	**n=0, y = 1*multiplier (see Appendix 2)**	**n**
303	**Agricultural/forestry/horticultural weed**	**n=0, y = 2*multiplier (see Appendix 2)**	**y**
304	**Environmental weed**	**n=0, y = 2*multiplier (see Appendix 2)**	**y**
305	**Congeneric weed**	**n=0, y = 1*multiplier (see Appendix 2)**	**y**
401	**Produces spines, thorns or burrs**	**y=1, n=0**	**n**
402	**Allelopathic**	**y=1, n=0**	
403	**Parasitic**	**y=1, n=0**	**n**
404	**Unpalatable to grazing animals**	**y=1, n=-1**	**y**
405	**Toxic to animals**	**y=1, n=0**	**n**
406	**Host for recognized pests and pathogens**	**y=1, n=0**	**y**
407	**Causes allergies or is otherwise toxic to humans**	**y=1, n=0**	**n**
408	**Creates a fire hazard in natural ecosystems**	**y=1, n=0**	**n**
409	**Is a shade tolerant plant at some stage of its life cycle**	**y=1, n=0**	**n**
410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y=1, n=0**	**y**

411	**Climbing or smothering growth habit**	**y=1, n=0**	**n**
412	**Forms dense thickets**	**y=1, n=0**	**y**
501	**Aquatic**	**y=5, n=0**	**n**
502	**Grass**	**y=1, n=0**	**n**
503	**Nitrogen fixing woody plant**	**y=1, n=0**	**y**
504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**y=1, n=0**	**n**
601	**Evidence of substantial reproductive failure in native habitat**	**y=1, n=0**	**n**
602	**Produces viable seed**	**y=1, n=-1**	**y**
603	**Hybridizes naturally**	**y=1, n=-1**	**n**
604	**Self-compatible or apomictic**	**y=1, n=-1**	**y**
605	**Requires specialist pollinators**	**y=-1, n=0**	**n**
606	**Reproduction by vegetative fragmentation**	**y=1, n=-1**	**n**
607	**Minimum generative time (years)**	**1 year = 1, 2 or 3 years = 0, 4+ years = -1**	**>3**
701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y=1, n=-1**	**n**
702	**Propagules dispersed intentionally by people**	**y=1, n=-1**	**y**
703	**Propagules likely to disperse as a produce contaminant**	**y=1, n=-1**	**n**
704	**Propagules adapted to wind dispersal**	**y=1, n=-1**	**n**
705	**Propagules water dispersed**	**y=1, n=-1**	**n**
706	**Propagules bird dispersed**	**y=1, n=-1**	**y**
707	**Propagules dispersed by other animals (externally)**	**y=1, n=-1**	**n**
708	**Propagules survive passage through the gut**	**y=1, n=-1**	**y**
801	**Prolific seed production (>1000/m2)**	**y=1, n=-1**	**y**
802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**y=1, n=-1**	**y**
803	**Well controlled by herbicides**	**y=-1, n=1**	**y**
804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y=1, n=-1**	**y**
805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	**y=-1, n=1**	**y**

Designation: H(HPWRA) **WRA Score** **17**

Supporting Data:

101	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is the species highly domesticated? No] No evidence
102	2011. WRA Specialist. Personal Communication.	NA
103	2011. WRA Specialist. Personal Communication.	NA
201	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Species suited to tropical or subtropical climate(s) 2-high] "Native to the Canary Islands, Madeira, and the Azores; in Hawaii naturalized and a serious pest, becoming dominant in many areas, occurring in mesic to wet forest, 150-1310 m, on Kauai, Oahu, Lanai, Maui and Hawaii." [Naturalization in the Hawaiian Islands, at relatively low elevations, indicates that this species is well suited to tropical and subtropical climates]
201	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Species suited to tropical or subtropical climate(s) 2-high] "M. faya, the fire tree, is native to the Atlantic islands of the Azores, Madeira and the Canaries, where it is a component of mid altitude forests."
202	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Quality of climate match data? 2-high] "Native to the Canary Islands, Madeira, and the Azores; in Hawaii naturalized and a serious pest, becoming dominant in many areas, occurring in mesic to wet forest, 150-1310 m, on Kauai, Oahu, Lanai, Maui and Hawaii." [Naturalization in the Hawaiian Islands, at relatively low elevations, indicates that this species is well suited to tropical and subtropical climates]
202	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Quality of climate match data? 2-high] "M. faya, the fire tree, is native to the Atlantic islands of the Azores, Madeira and the Canaries, where it is a component of mid altitude forests."
203	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Broad climate suitability (environmental versatility)? Yes] "naturalized and a serious pest, becoming dominant in many areas, occurring in mesic to wet forest, 150-1,310 m" [Elevation range exceeds 1000 m, demonstrating environmental versatility]
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] "In its native range, the distribution of M. faya is very much determined by rainfall and temperature. Frost appears to be a major limiting factor as the tree has not been recorded more than 100 m above the frost line. The minimum amount of annual rainfall necessary for the occurrence of the tree is about 500 mm. In some forests, fog drips are a significant source of water and the tree is therefore rarely encountered above the high moisture cloud zone. The mean annual rainfall range is 1270-2540 mm and mean annual temperature may be as high as 22°C...In the Macaronesian islands, the altitudinal range of M. faya is 400-1500 m, however, this can vary greatly between islands, with the upper altitudinal limit for example ranging from 600 to 1500 m. In Hawaii, M. faya occurs between 150 and 2000 m altitude, but does not regenerate naturally at either altitudinal extreme."
204	1999. Oppenheimer, H.L./Meidell, J.S./Bartlett, R.T.. New plant records for Maui and Moloka'i. Bishop Museum Occasional Papers. 59: 7-11.	[Native or naturalized in regions with tropical or subtropical climates? Yes] "According to Wagner et al. (1990: 931), firetree is naturalized on Kaua'i, O'ahu, Läna'i, Maui and Hawai'i. A search at BISH revealed that all the collections from Maui were made on East Maui, the earliest in 1929 (D. Cooke s. n., Haleakalä, 4300 ft). The following specimen represents a range extension to West Maui. Material examined. MAUI: West Maui, Lahaina District, West Maui Natural Area Reserve— Pana'ewa Section, growing on a hilltop South of Kanahä Valley, East of Pa'upa'u, 769 m, 28 Jun 1998, Oppenheimer H69802 ."
204	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Native or naturalized in regions with tropical or subtropical climates? Yes] "Native to the Canary Islands, Madeira, and the Azores; in Hawaii naturalized and a serious pest, becoming dominant in many areas, occurring in mesic to wet forest, 150-1310 m, on Kauai, Oahu, Lanai, Maui and Hawaii." [Naturalization in the Hawaiian Islands, at relatively low elevations, indicates that this species is well suited to tropical and subtropical climates]
205	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Does the species have a history of repeated introductions outside its natural range? Yes. Introduced into at least four locations outside native range] "M. faya has not been widely introduced around the world but it is known to be present in the Hawaiian Islands, Florida, Australia and New Zealand. On all the main Hawaiian islands the species has become a major environmental weed. In New Zealand it is cultivated but has only been reported as naturalized from the Chatham Islands (Owen, 1997). Habitats invaded in Hawaii reflect those occupied by the species in its native range (Lutzow-Felling et al., 1995; Arévalo and Fernández-Palacios, 2000). "

301	1999. Oppenheimer, H.L./Meidell, J.S./Bartlett, R.T.. New plant records for Maui and Molokaʻi. Bishop Museum Occasional Papers. 59: 7-11.	[Naturalized beyond native rang? Yes] "The following specimen represents a range extension to West Maui. Material examined. MAUI: West Maui, Lahaina District, West Maui Natural Area Reserve— Panaʻewa Section, growing on a hilltop South of Kanahä Valley, East of Paʻupaʻu, 769 m, 28 Jun 1998, Oppenheimer H69802 ."
301	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawaiʻi Press and Bishop Museum Press, Honolulu, HI.	[Naturalized beyond native rang? Yes] "Native to the Canary Islands, Madeira, and the Azores; in Hawaii naturalized and a serious pest, becoming dominant in many areas, occurring in mesic to wet forest, 150-1310 m, on Kauai, Oahu, Lanai, Maui and Hawaii."
301	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Naturalized beyond native range? Yes] " In New Zealand it is cultivated but has only been reported as naturalized from the Chatham Islands (Owen, 1997)."
302	1992. Whiteaker, L.D./Gardner, D.E.. Firetree (Myricafaya) Distribution in Hawai`i. Pp. 225-240 in Stone et al. (eds.). Alien Plant Invasions in Native Ecosystems of Hawaii: Management & Research. Coop. Nat. Park Res. Studies Unit, U. of Hawaii, Honolulu,	[Garden/amenity/disturbance weed? A disturbance adapted weed with negative ecological and agricultural (i.e. ranching) impacts] "More generally, the distribution of firetree throughout the State seems associated with disturbance. Major areas of infestation are pastures, roadsides, trails, secondary forest, and steep, unstable slopes."
303	1992. Whiteaker, L.D./Gardner, D.E.. Firetree (Myricafaya) Distribution in Hawai`i. Pp. 225-240 in Stone et al. (eds.). Alien Plant Invasions in Native Ecosystems of Hawaii: Management & Research. Coop. Nat. Park Res. Studies Unit, U. of Hawaii, Honolulu,	[Agricultural/forestry/horticultural weed? Yes] "The Hawaiian Sugar Planters' Association obtained seeds of firetree from a Portuguese farmer on the island of Hawai'i for use in reforestation attempts (Fosberg 1937). Plantings were made on the islands of Kauai, Oahu, and Hawai`i (Skolmen 1979), most of them in the 1920s. The aggressive, noxious character of this species was soon noted, along with its spread to Maui (Fosberg 1937). The continued spread of firetree led the Territorial Board of Agriculture and Forestry to begin attempts to eradicate it in 1944 (Neal 1965). Managers of Shipman Estate observed firetree spreading in the Volcano area on the island of Hawai`i in the mid-1940s. In the mid 1960s, Shipman attempted to control the species there (T. Lindsey, pers. comm.). It was declared noxious for state land leases because it spreads rapidly and forms a dense cover that crowds out desirable species (Hosaka 1945; Haselwood and Motter 1983). Firetree has continued to spread despite efforts by the State and the National Park Service, and it now occurs on all major Hawaiian Islands except Kahoolawe, Molokai, and Niihau. Estimates of the total infested area have increased over the years: 8,200 a (3,280 ha) (Yamayoshi 1954), 21,375 a (8,550 ha) (Anonymous 1962), 40,000 a (16,000 ha) (Walters and Null 1970), and the most recent estimate, showed 53,938 a (21,575 ha) to be supporting firetree populations of various densities (Watanabe 1982). Hawai`I contained 50,000 a (20,000 ha); Maui, 3,000 a (1,200 ha); Oahu, 100 a (40 ha); Kauai, 325 a (130 ha); and Lanai, 512 a (205 ha)...An infestation of firetree occurs on the Kapapala Ranch (Ka`u District) adjacent to the Ainapo Cabin between 3,500 and 3,760 ft (1,060-1,140 m) elevation. The infestation occupies 80 a (32 ha). This ranchland consists of pasture mixed with stands or alien shrubs and trees on steeper slopes. Firetree has also been reported in the Kiolaka`a-Kea`a Homesteads Addition portion of the Ka`u Forest Reserve at 2,300 ft (720 m) elevation. A single plant was recorded on a Hawai`i State Division of Forestry survey of this area (L.W. Cuddihy and S.J. Anderson, pers. comm.)."
303	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Agricultural/forestry/horticultural weed? Yes] " This tree is primarily associated with primary succession, such as colonization of old lava flows. However, it is also common on pasture lands in Hawaii where the weedy nature of the tree was first recognized."
304	1989. Vitousek, P. M./Walker, L. R.. Biological Invasion by Myrica Faya in Hawai'i: Plant Demography, Nitrogen Fixation, Ecosystem Effects. Ecological Monographs. 59: 247-265.	[Environmental weed? Yes] "We conclude that biological invasion by Myrica faya alters ecosystem-level properties in this young volcanic area; at least in this case, the demography and physiology of one species controls characteristics of a whole ecosystem."
304	1990. Aplet, G.H.. Alteration of Earthworm Community Biomass by the Alien Myrica faya in Hawai'i. Oecologia. 82(3): 414-416.	[Environmental weed? Yes] "Populations of exotic earthworms responded positively to the presence of the nitrogen fixing tree, Myrica faya, which is currently invading early successional habitats in Hawaii Volcanoes National Park. Earthworm biomass in one high-density stand of Myrica was over three times the levels in nearby submontane forest and rainforest. Comparisons of earthworm populations under pairs of Myrica and the dominant native tree, Metrosideros polymorpha, showed biomass levels to be elevated from over two- to almost eightfold under the exotic tree. The increased rate of burial of nitrogen-rich litter by earthworms can alter the rate of nitrogen accretion and cycling in these ecosystems."

304	1990. Vitousek, P.M.. Biological Invasions and Ecosystem Processes: Towards an Integration of Population Biology and Ecosystem Studies. Oikos. 57(1): 7-13.	[Environmental weed? Yes] "...consequently biological invasion by Myrica faya has been shown to alter ecosystem-level properties of young volcanic sites in HVNP by adding fixed nitrogen. The population level processes which permit and/or facilitate its invasion, together with the physiological characteristics which cause it to alter nitrogen budgets, therefore have important consequences to local ecosystems."
304	1991. Walker, L.R./Vitousek, P.M.. An Invader Alters Germination and Growth of Native Dominant Tree in Hawai'i. Ecology. 72(4): 1449-1455.	[Environmental weed? Yes] "It is possible that Myrica N additions ultimately will favor establishment and growth of other N demanding exotics such as Psidium cattleianum Sabine (Vitousek and Walker 1989). However, present Myrica forests are vigorous, monospecific communities with virtually no understory. As no Myrica regeneration is being observed in these stands, the Myrica trees may facilitate subsequent invasion by exotics only as they senesce."
304	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Environmental weed? Yes] "It was introduced to Hawaii where it has become a serious invasive weed in the Volcanoes National Park, and is resisting all attempts at its eradication."
305	2008. Kurten, E.L./Snyder, C.P./Iwata, T./Vitousek, P.M.. Morella cerifera invasion and nitrogen cycling on a lowland Hawaiian lava flow. Biological Invasions. 10: 19-24.	[Congeneric weed? Yes] "Abstract Invasive plants that fix nitrogen can alter nutrient availability and thereby community dynamics and successional trajectories of native communities they colonize. Morella cerifera (Myricaceae) is a symbiotic nitrogen fixer originally from the southeastern U.S. that is colonizing native dominated vegetation on a young lava flow near Hilo, Island of Hawai'i, where it increases total and biologically available soil nitrogen and increases foliar nitrogen concentrations in associated individuals of the native tree Metrosideros polymorpha. This invasion has the potential to alter the few remaining native dominated lowland forest ecosystems in windward Hawai'i."
401	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Produces spines, thorns or burrs? No] "Evergreen shrubs or small trees up to 8 m tall; branches with reddish peltate hairs. Leaves coriaceous, oblanceolate, 4-11 cm long, 1-2.5 cm wide, glabrous, glandular dots inconspicuous, margins somewhat revolute, remotely serrulate or serrate in upper ½, apex rounded to acute."
402	1990. Walker, L.R.. Germination of an Invading Tree Species (Myrica faya) in Hawaii. Biotropica. 22(2): 140-145.	[Allelopathic? Potentially] "Leaf litter of both M. faya and M. polymorpha reduce germination of M. faya fruits. This reduction may be from the physical effect of burial (germination was also reduced by burial in vermiculite), or from allelopathic effects of leachate from M. faya and M. polymorpha litter. Allelopathic effects have been suggested for M. faya (Whiteaker & Gardner 1985) and M. cerifera (Dunevitz & Ewel 1981) but are difficult to prove conclusively."
402	1992. Whiteaker, L.D./Gardner, D.E.. Firetree (Myricafaya) Distribution in Hawai`i. Pp. 225-240 in Stone et al. (eds.). Alien Plant Invasions in Native Ecosystems of Hawaii: Management & Research. Coop. Nat. Park Res. Studies Unit, U. of Hawaii, Honolulu,	[Allelopathic? Potentially] "The absence of other plant species under the canopy may be due partially to shading. However, allelopathic activity has been reported for a closely related species (M. cerifera) from the southeastern United States (Dunevitz and Ewel 1981). Thus, the lack of understory in firetree stands may be due not only to canopy shading, but also to allelopathic activity (Smith 1985)."
403	2011. WRA Specialist. Personal Communication.	[Parasitic? No] No evidence
404	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Unpalatable to grazing animals? Yes] "The effectiveness of fayatree control by intensive grazing or browsing by pasture and rangeland livestock was also considered, as was use of goats in National Park areas (unpublished). However, in such trials fayatree did not appear to be a preferred fodder for livestock, and only the young shoots were selected. After small trees grew to the extent that most new growth was beyond the animals' reach, browsing pressure became negligible. Goats maintained in pens with fayatree as the most available food nevertheless avoided fayatree and attempted to escape before it was fed upon. These results appear to contrast with the observation described in "Ethnobotanical Uses" that fayatree may have been used to some extent for livestock feed in its native habitats."
405	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Toxic to animals? No] No evidence

406	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Host for recognized pests and pathogens? Yes] "M. faya suffers from a number of diseases resulting in canker, dieback and root rot. Nectria galligena, common throughout its native range, causes severe canker and galls. The dieback disease, Ramularia destructiva, may be especially severe on the shoots of young plants or stump coppice. It may also cause premature shedding of flowers and fruits (Gardner and Hodges, 1990). In Hawaii, Botrytis cinerea causes fruit rot and up to half of the fruits have been reported as infected (Duffy and Gardner, 1994). The leafhopper Sophonia rufofascia Kuoh and Kuoh (Homoptera: Cicadellidae) was first reported in the state of Hawaii in 1987 probably resulting from an accidental introduction from Asia. It feeds on the leaf phloem of a wide host plant range. The insect has a major impact on tree health including a reduction in leaf size, constriction of leaf xylem diameters, leaf chlorosis and necrosis, and is probably the main or sole cause of the dieback exhibited by M. faya since the late 1990s (Lenz and Taylor, 2001)...As M. faya facilitates an increase in the polyphagous Sophonia rufofascia abundance, this could cause some economic impact on fruit crops where M. faya is present. There are, however, no quantitative assessments of economic damage caused by M. faya."
407	2004. Brooks, M.L./D'Antonio, C.M./Richardson, D.M./Grace, J.B./Keeley, J.E./DiTomaso, J.M./Hobbs, R.J./Pellant, M./Pyke, D.. Effects of Invasive Alien Plants on Fire Regimes. BioScience. 54(7): 677-688.	[Causes allergies or is otherwise toxic to humans? No] "Several mothers said that small children would pick the ripe fruit and chew it, but that this practice was discouraged, not because the fruit was thought to be poisonous, but that it made stains that were difficult to wash out of the children's clothes. An occasional account heard in Hawai'i (see Yarnayoshi 1954) was that local Portuguese people used fayatree fruit as preserves. This use was not mentioned or confirmed by any of the people interviewed during four visits to the Azores"
408	2004. Brooks, M.L./D'Antonio, C.M./Richardson, D.M./Grace, J.B./Keeley, J.E./DiTomaso, J.M./Hobbs, R.J./Pellant, M./Pyke, D.. Effects of Invasive Alien Plants on Fire Regimes. BioScience. 54(7): 677-688.	[Creates a fire hazard in natural ecosystems? No] "Invasion of the nitrogen-fixing tree Myrica faya into grass dominated sites in Hawaii is likely to decrease the rate of fire spread, because Myrica typically maintains higher fuel moisture than the dominant native grasses. Furthermore, in closed stands, the moisture content of Myrica leaf litter can be very high because of the high relative humidity in the subcanopy, which reaches 50% to 60% (Tim Tunison, Hawaii Volcanoes National Park, Honolulu, personal communication, 14 October 2003).However, extreme drought conditions could change these relationships."
409	1990. Walker, L.R.. Germination of an Invading Tree Species (Myrica faya) in Hawaii. Biotropica. 22(2): 140-145.	[Is a shade tolerant plant at some stage of its life cycle? No] "Dense shade under closed canopy M. polymorpha forests or open habitats with <50 percent shade are also unfavorable for germination. High surface temperatures (>45?C), such as found on volcanic cinder, may reduce germination in very open habitats (Grime et al. 1981). Therefore, the ideal germination sites (and areas where M. faya is invading most rapidly) are open forests with enough native trees to serve as perches and provide some shade but not enough trees to form a closed canopy (Vitousek et al. 1987)."
409	2003. Arévalo, J.R./Fernández-Palacios, J.M.. Spatial Patterns of Trees and Juveniles in a Laurel Forest of Tenerife, Canary Islands. Plant Ecology. 165(1): 1-10.	[Is a shade tolerant plant at some stage of its life cycle? No] "Shade-intolerant species can be characterized by the dependence of their seed germination on direct sun light (Myrica faya)…"
409	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is a shade tolerant plant at some stage of its life cycle? No] "Being a light-demanding species it does not regenerate under its own canopy light (Fernández-Palacios and Arévalo, 1998), and typically natural regeneration takes place on old lava flows or in open vegetation."
410	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions ? Yes] "In Hawaii, M. faya has been found in 11 soil types and with soil pH of 5-6 in forest soil in Tenerife, Canary Islands (Whiteaker and Gardner, 1992; Fernández-Palacios and Arévalo, 1998)."
411	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Climbing or smothering growth habit? No] "Evergreen shrubs or small trees up to 8 m tall; branches with reddish peltate hairs."
412	1991. Walker, L.R./Vitousek, P.M.. An Invader Alters Germination and Growth of Native Dominant Tree in Hawai'i. Ecology. 72(4): 1449-1455.	[Forms dense thickets? Yes] "Although Myrica does not readily invade closed, late-successional Metrosideros forests, on young, volcanically disturbed soils it is rapidly establishing dense, monospecific stands under which Metrosideros does not regenerate."

412	1992. Whiteaker, L.D./Gardner, D.E.. Firetree (Myricafaya) Distribution in Hawai`i. Pp. 225-240 in Stone et al. (eds.). Alien Plant Invasions in Native Ecosystems of Hawaii: Management & Research. Coop. Nat. Park Res. Studies Unit, U. of Hawaii, Honolulu,	[Forms dense thickets? Yes] "An estimated 15,000 a (6,000 ha) of infestation along the Hamakua coast on the island of Hawai`i has been classified as "heavy" (Watanabe 1982). In this region firetree grows over 50 ft (16 m) tall and forms dense, interlocking canopies with no understory (Smathers and Gardner 1979). The absence of other plant species under the canopy may be due partially to shading. However, allelopathic activity has been reported for a closely related species (M. cerifera) from the southeastern United States (Dunevitz and Ewel 1981). Thus, the lack of understory in firetree stands may be due not only to canopy shading, but also to allelopathic activity (Smith 1985)."
501	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Aquatic? No] "Evergreen shrubs or small trees up to 8 m tall; branches with reddish peltate hairs." [Terrestrial]
502	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Grass? No] ""Evergreen shrubs or small trees…" [Myricaceae]
503	1987. Vitousek, P.M./Walker, L.R./Whiteaker, L.D./Mueller-Dombois, D./Matson, P.A.. Biological Invasion by Myrica faya Alters Ecosystem Development in Hawaii. Science. 238(4828): 802-804.	[Nitrogen fixing woody plant? Yes] "The exotic nitrogen-fixing tree Myrica faya invades young volcanic sites where the growth of native plants is limited by a lack of nitrogen. Myrica quadruples the amount of nitrogen entering certain sites and increases the overall biological availability of nitrogen, thereby altering the nature of ecosystem development after volcanic eruptions."
504	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Evergreen shrubs or small trees up to 8 m tall;"
601	2003. Arévalo, J.R./Fernández-Palacios, J.M.. Spatial Patterns of Trees and Juveniles in a Laurel Forest of Tenerife, Canary Islands. Plant Ecology. 165(1): 1-10.	[Evidence of substantial reproductive failure in native habitat? No] No evidence
602	1990. Walker, L.R.. Germination of an Invading Tree Species (Myrica faya) in Hawaii. Biotropica. 22(2): 140-145.	[Produces viable seed? Yes] "Myrica faya Ait. (Myricaceae), an introduced tree species, is rapidly invading disturbed areas of Hawaii Volcanoes National Park. The effects of fruit age, number of seeds per fruit, passage through bird guts, leaf litter, shade, and endocarp scarification on germination of M. faya were measured. Germination of M. faya seeds was >80 percent at 10 weeks, declining to 30 percent after 78 weeks of dry storage. Mesocarp removal and endocarp scarification slightly increased germination at 15 weeks but not at 92 weeks; more seeds per fruit and passage through birds had no effect. Leaf litter from M. faya trees and the native Metrosideros polymorpha trees reduced germination. Germination was highest at intermediate shade. Therefore, bird dispersal away from dense forest stands to disturbed areas with intermediate light levels increases the chances of germination for this species."
603	2008. Kurten, E.L./Snyder, C.P./Iwata, T./Vitousek, P.M.. Morella cerifera invasion and nitrogen cycling on a lowland Hawaiian lava flow. Biological Invasions. 10: 19-24.	[Hybridizes naturally? No] "While M. faya is restricted to montane areas in the Hawaiian Islands, its congener Morella (Myrica) cerifera has been introduced at lower elevations." No evidence of hybridization, despite overlap in ranges
604	1989. Vitousek, P. M./Walker, L. R.. Biological Invasion by Myrica Faya in Hawai'i: Plant Demography, Nitrogen Fixation, Ecosystem Effects. Ecological Monographs. 59: 247-265.	[Self-compatible or apomictic? Potentially] "Myrica faya is considered dioecious, but nominally male plants generally produce some fruit and female plants a few male inflorescences (Gardner 1985)."
604	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Self-compatible or apomictic? Yes] "Thus, this primarily out-breeding species can undergo temporary reversal to self-compatibility by producing functional pistillate or staminate organs on a typically unisexual plant (this form of reproductive plasticity is sometimes referred to as subdioecy (Lloyd 1981)."
605	1989. Vitousek, P. M./Walker, L. R.. Biological Invasion by Myrica Faya in Hawai'i: Plant Demography, Nitrogen Fixation, Ecosystem Effects. Ecological Monographs. 59: 247-265.	[Requires specialist pollinators? No] "It appears to be wind pollinated, but in Hawai'I it is also visited by introduced honeybees (Apis mellifera)...Many aspects of its biology interact to make Myrica capable of rapid invasion. It can be wind-pollinated, and so is not dependent on biological pollen-vectors."
606	1989. Vitousek, P. M./Walker, L. R.. Biological Invasion by Myrica Faya in Hawai'i: Plant Demography, Nitrogen Fixation, Ecosystem Effects. Ecological Monographs. 59: 247-265.	[Reproduction by vegetative fragmentation? No] No evidence

606	1991. Walker, L.R./Vitousek, P.M.. An Invader Alters Germination and Growth of Native Dominant Tree in Hawai'i. Ecology. 72(4): 1449-1455.	[Reproduction by vegetative fragmentation? No] No evidence
607	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Minimum generative time (years)? 6+] "Fayatree has been observed to begin fruiting at an early stage of development (trees with 2 to 3 cm basal diameter and a mean age of 6 years) and to increase fruit production at an incremental rate directly related to the maturity of the tree (Smathers and Gardner 1979, Vitousek and Walker 1989)."
701	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No] "There is a low risk of accidental introductions and introduction for ornamental purposes is the most likely pathway for the species to spread into new regions."
702	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Propagules dispersed intentionally by people? Yes] "Being non-deciduous, and with its variable color (dark green older leaves and lighter green new leaves) and persistent, dense foliage, young fayatrees are attractive as shrubs and frequently have been seen as ornamentals in private yards, parks, and public buildings such as airports. Mature trees observed were generally quite knarled and had more sparse, open foliage. The most abundant stand of these "urban" trees is found in a park on the island of Sao Miguel in the bottom of the inactive crater "Caldeira da Sete Caidadea"."
703	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules likely to disperse as a produce contaminant? No] "There is a low risk of accidental introductions and introduction for ornamental purposes is the most likely pathway for the species to spread into new regions."
704	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai‘i Press and Bishop Museum Press, Honolulu, HI.	[Propagules adapted to wind dispersal? No] "Fruit drupaceous, dark red or blackish when mature, slightly fleshy"
705	1989. Vitousek, P. M./Walker, L. R.. Biological Invasion by Myrica Faya in Hawai'i: Plant Demography, Nitrogen Fixation, Ecosystem Effects. Ecological Monographs. 59: 247-265.	[Propagules water dispersed? No] No evidence
705	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Propagules water dispersed? No] No evidence
706	1985. LaRosa, A.M./Smith, C.W./Gardner, D.E.. Role of Alien and Native Birds in the Dissemination of Firetree (Myrica faya Ait.-Myriacaceae) and Associated Plants in Hawaii □. Pacific Science. 39(4): 372-378.	[Propagules bird dispersed? Yes] "ABSTRACT: The food habits of several forest birds and their potential role in the dispersal of firetree (Myrica faya) were studied in two areas of Hawaii Volcanoes National Park. Observations were made during peak firetree fruiting (October-November 1983) in areas where 'ohi'a (Metrosideros polymorpha) and firetree are codominant. Both native and introduced birds foraged in firetree and 'ohi' a, but introduced birds were more common in firetree. Of the six bird species observed, 'oma'o (Phaeornis obscurus) and house finches (Carpodacus mexicanus) were the principal dispersal agents in the areas studied, while the common 'amakihi (Hemignathus virens) was secondarily important. Japanese white eyes (Zosterops japonicus), though feeding on the fruit , rarely ingested the seed. 'Apapane (Himatione sanguinea) and Northern American cardinals (Cardinalis cardinalis) were not observed eating firetree fruit. Germination rates and successes of several native and alien species are generally unaffected by passage through the digestive tracts of captive Japanese white-eyes and common mynas (Acridotheres tristis)."
706	1989. Vitousek, P. M./Walker, L. R.. Biological Invasion by Myrica Faya in Hawai'i: Plant Demography, Nitrogen Fixation, Ecosystem Effects. Ecological Monographs. 59: 247-265.	[Propagules bird dispersed? Yes] "The fruit is an edible drupe that contains a stony endocarp; it is believed to be bird-dispersed in its native range (Bannerman 1922) and can be dispersed by birds or feral pigs (Sus scrofa) in Hawai'i (Smathers and Gardner 1979, LaRosa et al. 1985)."
706	1990. Woodward, S.A./Vitousek, P.M./Matson, K./Hughes, F./Benvenuto, K./Matson, P. A.. Use of the Exotic Tree Myrica faya by Native and Exotic Birds in Hawai'i Volcanoes National Park. Pac ific Science. 44(1): 88-93.	[Propagules bird dispersed? Yes] "ABSTRACT: The exotic nitrogen-fixing tree Myrica faya is invading Hawai'i Volcanoes National Park (HAVO). Observations of avian use of M. faya demonstrated that although four species of native birds visited the trees, they rarely fed on the fruits. Seven species of exotic birds were seen visiting M. faya, and five of these were observed ingesting the fruit. The most frequent visitor and consumer was the Japanese White-eye (Zosterops japonicus). Over one-third of the captured Z. japonicus produced fecal samples containing M. faya seeds, and those seeds were as viable as those picked from M. faya trees and beneath their canopies."

707	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Propagules dispersed by other animals (externally)? No] "Fruit drupaceous, dark red or blackish when mature, slightly fleshy" [No means of external attachment
708	1985. LaRosa, A.M./Smith, C.W./Gardner, D.E.. Role of Alien and Native Birds in the Dissemination of Firetree (Myrica faya Ait.-Myriacaceae) and Associated Plants in Hawaii . Pacific Science. 39(4): 372-378.	[Propagules survive passage through the gut? Yes] "Germination rates and successes of several native and alien species are generally unaffected by passage through the digestive tracts of captive Japanese white-eyes and common mynas (Acridotheres tristis)."
708	1990. Walker, L.R.. Germination of an Invading Tree Species (Myrica faya) in Hawaii. Biotropica. 22(2): 140-145.	[Propagules survive passage through the gut? Yes] "Mesocarp removal and endocarp scarification (likely results of passage through a bird's gut; Janzen 1983) both increased M. faya germination in this study"
708	1990. Woodward, S.A./Vitousek, P.M./Matson, K./Hughes, F./Benvenuto, K./Matson, P. A.. Use of the Exotic Tree Myrica faya by Native and Exotic Birds in Hawai'i Volcanoes National Park. Pac ific Science. 44(1): 88-93.	[Propagules survive passage through the gut? Yes] "Seven species of exotic birds were seen visiting M. faya, and five of these were observed ingesting the fruit. The most frequent visitor and consumer was the Japanese White-eye (Zosterops japonicus). Over one-third of the captured Z. japonicus produced fecal samples containing M. faya seeds, and those seeds were as viable as those picked from M. faya trees and beneath their canopies."
801	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Prolific seed production (>1000/m2)? Yes] "An essentially male fayatree has the capacity to produce more than 4,000 fruits/year, compared to more than 37,000 fruits/year for a female tree (Whiteaker and Gardner 1987)."
801	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Prolific seed production (>1000/m2)? Yes] "Up to 20,000 seeds per tree are produced every year. "
802	1990. Walker, L.R.. Germination of an Invading Tree Species (Myrica faya) in Hawaii. Biotropica. 22(2): 140-145.	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "Germination of M. faya seeds was >80 percent at 10 weeks, declining to 30 percent after 78 weeks of dry storage. Mesocarp removal and endocarp scarification slightly increased germination at 15 weeks but not at 92 week"
802	1998. Drake, D.R.. Relationships among the Seed Rain, Seed Bank and Vegetation of a Hawaiian Forest. Journal of Vegetation Science. 9(1): 103-112.	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "At Kealakomo, the seed bank was dominated by alien species, most of which were abundant in the seed bank year-round...two alien species in the seed bank, Andropogon virginicus and Myrica faya, have the potential, once established, to completely alter the ecosystem at Kealakomo."
802	2000. Arevalo, J.R.Fernandez-Palacios, J.M.. Seed bank analysis of tree species in two stands of the Tenerife laurel forest (Canary Islands). Forest Ecology and Management. 130: 177-185.	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "Germination was much higher in summer than in winter, especially from Moquinal seed bank. Shade tolerant species (Laurus azorica, Persea indica, Rhamnus glandulosa and Viburnum tinus) have a shorter germination delay than shade-intolerant species (Erica arborea, Erica scoparia and Myrica faya), which dominate the seed bank. The species composition of germinating seeds after one year did not reveal any differences between sites nor between, despite the high differences in number between seasons."
803	1992. Whiteaker, L.D./Gardner, D.E.. Firetree (Myricafaya) Distribution in Hawai`i. Pp. 225-240 in Stone et al. (eds.). Alien Plant Invasions in Native Ecosystems of Hawaii: Management & Research. Coop. Nat. Park Res. Studies Unit, U. of Hawaii, Honolulu,	[Well controlled by herbicides? Yes] "Herbicides are the primary control agents. Of the various herbicides used by the State, Tordon 22K (picloram) has been the most effective, producing a complete canopy kill and a 99% control of resprouting (Walters and Null 1970; Smathers and Gardner 1979; R. Kami, pers. comm.). In Hawai`i Volcanoes National Park, basal bark application of a 4% solution of KURON (silvex) in diesel oil was effective, and a method to introduce ROUNDUP (glyphosate) directly into the vascular tissue of firetree through a cut branch was suggested for remote areas and less-than-ideal weather conditions (Gardner and Kageler 1982). In some areas, pasturelands have been cleared of invading firetree with bulldozers by private landowners. However, follow-up monitoring and/or herbicide treatment of stumps and brush piles are needed with mechanical methods to control resprouting (R. Kami, pers. comm.)."
803	2003. Motooka, P./Castro, L./Nelson, D./Nagai, G./Ching,L.. Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. CTAHR, UH Manoa, Honolulu, HI http://www.ctahr.hawaii.edu/invweed/weedsHi.html	[Well controlled by herbicides? Yes] "Saplings susceptible to foliar applications of triclopyr. Susceptible to cut-stump treatments of imazapyr 9% product in water, 10% triclopyr amine product, 100% glyphosate; metsulfuron (concentration not disclosed) and to frill application of 50% triclopyr amine product (HAVO). Trees and saplings susceptible to cut surface applications of picloram, triclopyr and glyphosate, and tolerant of dicamba. Saplings susceptible to basal bark applications of triclopyr. Soil applied hexazinone, tebuthiuron ineffective"

804	1985. Smith, C.W.. Impact of Alien Plants on Hawaii's Native Biota. Pp. 180-250 in Stone & Scott (eds.). Hawaii's terrestrial ecosystems: preservation & management. CPSU, Honolulu, HI	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Trees are normally killed by fire, although regeneration from basal sprouts is possible."
804	1995. Lutzow-Felling C.J./Gardner, D.E./Markin, G.P./Smith, C.W.. Myrica faya: review of the biology, ecology, distribution and control, including an annotated bibliography. Technical Report 94. PCSU, University of Hawaii, Honolulu, HI	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Young trees may be successfully pulled from the ground and removed mechanically. Older trees may be clear cut, but the tendency for stumps to resprout profusely necessitates treatment with an herbicide for practical control."
805	1998. Adler, P.B./D'Antonio, C.M./Tunison, J.T.. Understory Succession Following a Dieback of Myrica faya in Hawai'i Volcanoes National Park. Pacific Science. 52(1): 69-78.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Yes] "In 1988, the introduced leafhopper Sophonia rufofascia (Kuoh & Kuoh) began causing M faya dieback (Yang et al. in press). Tree mortality is extensive, and over 1000 ha of woodland, previously heavily invaded by M. faya, contains stands of dead and decaying M. faya trees. Dieback is concentrated in the seasonal submontane zone of Hawai'I Volcanoes National Park and radiates out from a central area of severe dieback where more than 80% of trees are dead."