

Taxon: Ehretia microphylla Lam.	Family: Ehretiaceae
Common Name(s): Fukien tea Philippine tea	Synonym(s): Carmona microphylla (Lam.) G. Don Carmona retusa (Vahl) Masam. Cordia retusa Vahl Ehretia monopyrena Gottschling & ...

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 16 Jul 2018
WRA Score: 7.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Shrub/Tree, Invasive, Tea Substitute, Thicket-Forming, Bird-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
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	n
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)	y
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed		
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	n
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems		

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)		
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	n
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		
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)		
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)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
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)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	[No evidence of domestication] "Origin and geographic distribution Carmona is a monotypic genus. The only species C. retusa is found from India eastward to southern China, Taiwan and Japan, and further south throughout Malesia to New Guinea and the Solomon Islands. It is often grown as an ornamental."
	Ruengsawang, K., & Chantaranonthai, P. (2010). A revision of Boraginaceae subfamily Ehretioideae in Thailand. Thai Journal of Botany, 2(2), 113-125	[No evidence of domestication] "Thailand.— All provinces. Distribution.— India, Sri Lanka, Myanmar, Laos, Cambodia, Vietnam, China (Hainan, Kwangtung), Taiwan, Japan (Ryuku Island), Malesia."
102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA
103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 15 Jul 2018]	"Native Asia-Temperate CHINA: China [Guangdong (s.), Hainan] EASTERN ASIA: Japan, [Ryukyu Islands] Taiwan Asia-Tropical INDIAN SUBCONTINENT: India, Sri Lanka PAPUASIA: Indonesia, [Irian Jaya] Papua New Guinea, Solomon Islands INDO-CHINA: Indochina, Myanmar, Thailand MALESIA: Indonesia, [Celebes, Java, Lesser Sunda Islands, Moluccas, Sumatra] Malaysia, Philippines Australasia AUSTRALIA: Australia [Queensland (n.)]"

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 15 Jul 2018]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"C. retusa is a rare or locally common species found in open, dry, sunny habitats, such as thickets, shrub vegetation and teak forest at low and moderate elevations."
	Plants for a Future. (2018). <i>Carmona retusa</i> . https://pfaf.org/user/Plant.aspx?LatinName=Carmona+retusa . [Accessed]	"USDA hardiness: 10-12"

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L.L. 2006. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 87: 31-43	" <i>Carmona retusa</i> (scorpion bush, Philippine tea) was previously known from Kaua'i and Maui (Lorence et al., 1995; Starr et al., 2003). This prolific shrub is now also known from Moloka'i, where it is widely naturalized in and near Kaunakakai. Material examined. MOLOKA'I: Kaunakakai, Moloka'i Shores, volunteering in hard-to-reach places, widely cultivated and naturalized in this area, in association with <i>Schefflera actinophylla</i> and <i>Washingtonia</i> sp., 15 ft [5 m], 16 May 2005, Starr & Starr 050516-5."
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 15 Jul 2018]	"Native Asia-Temperate CHINA: China [Guangdong (s.), Hainan] EASTERN ASIA: Japan, [Ryukyu Islands] Taiwan Asia-Tropical INDIAN SUBCONTINENT: India, Sri Lanka PAPUASIA: Indonesia, [Irian Jaya] Papua New Guinea, Solomon Islands INDO-CHINA: Indochina, Myanmar, Thailand MALESIA: Indonesia, [Celebes, Java, Lesser Sunda Islands, Moluccas, Sumatra] Malaysia, Philippines Australasia AUSTRALIA: Australia [Queensland (n.)]"
	Starr, F., Starr, K. & Loope, L.L. 2003. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 74: 23-34	"Previously reported from Kaua'i and West Maui (Lorence et al., 1995), <i>C. retusa</i> is now also known from Hā'iku, East Maui where it can be found in lawns, along fences, and in hedges, often producing a carpet of seedlings. Material examined: MAUI: E. Maui, Hā'iku, scattered over mostly urban areas along Hā'iku Rd, 500 ft [152 m], 28 Nov 2000, Starr & Martz 001128-1."

Qsn #	Question	Answer
	Lorence, D.H., Flynn, T.W. & Wagner, W.L. 1995. Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. Bishop Museum Occasional Papers 41: 19-58	"This species is cultivated at least on Oahu and Kauai as a hedge plant. At the Kauai locality, <i>Carmona retusa</i> was collected in secondary vegetation of <i>Syzygiwn</i> , <i>Psidium</i> , <i>Leucaena</i> , and <i>Melinis</i> with forestry plantings. At the Maui site, collectors' notes indicate it is densely naturalized over several acres under kiawe (<i>Prosopis pallida</i>). The 2 described species of <i>Carmona</i> have recently been considered conspecific and treated as <i>C. retusa</i> (Thulin 1987: 413-17). This species has been identified as <i>C. microphylla</i> (Lam.) Don [syn. <i>Elzretia microphylla</i> Lam.] in the archipelago (SL John 1973: 287). Its occurrence on Kauai represents a new naturalized record of <i>Carmona</i> Cav. in Hawaii." ... "Material examined. KAUAI: Kawaihau District. Wailua House Lois by Nonou Forcs1 Reserve. 49- 213 m (160 -700 ft). 28 Jan 1991. T. Flynn & M. Egan 4390 (BISH. PTBG). MAUI: Wes1 Maui, lee side of Waihee Dunes. growing under kiawe forcs1. 19 Mar 1991. R. Hobdy 3286 (BISH. US)."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Wunderlin, R. P., B. F. Hansen, A. R. Franck, and F. B. Essig. 2018. Atlas of Florida Plants. http://florida.plantatlas.usf.edu/ . [Accessed 16 Jul 2018]	" <i>Ehretia microphylla</i> ... CULTIVATED."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"In Hawai'i it is grown by many Filipino and Chinese residents and also successfully grown as bonsai."
	de Padua, L.S., Bunyaphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"It is often grown as an ornamental."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L.L. 2006. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 87: 31-43	" <i>Carmona retusa</i> (scorpion bush, Philippine tea) was previously known from Kaua'i and Maui (Lorence et al., 1995; Starr et al., 2003). This prolific shrub is now also known from Moloka'i, where it is widely naturalized in and near Kaunakakai. Material examined. MOLOKA'I: Kaunakakai, Moloka'i Shores, volunteering in hard-to-reach places, widely cultivated and naturalized in this area, in association with <i>Schefflera actinophylla</i> and <i>Washingtonia</i> sp., 15 ft [5 m], 16 May 2005, Starr & Starr 050516-5."
	Starr, F., Starr, K. & Loope, L.L. 2003. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 74: 23-34	"Previously reported from Kaua'i and West Maui (Lorence et al., 1995), <i>C. retusa</i> is now also known from Hā'iku, East Maui where it can be found in lawns, along fences, and in hedges, often producing a carpet of seedlings. Material examined: MAUI: E. Maui, Hā'iku, scattered over mostly urban areas along Hā'iku Rd, 500 ft [152 m], 28 Nov 2000, Starr & Martz 001128-1."

Qsn #	Question	Answer
	<p>Lorence, D.H., Flynn, T.W. & Wagner, W.L. 1995. Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. Bishop Museum Occasional Papers 41: 19-58</p>	<p>"This species is cultivated at least on Oahu and Kauai as a hedge plant. At the Kauai locality , <i>Carmona retusa</i> was collected in secondary vegetation of <i>Syzygiwn</i>, <i>Psidium</i>, <i>Leucaena</i>, and <i>Melinis</i> with forestry plantings. At the Maui site, collectors' notes indicate it is densely naturalized over several acres under kiawe (<i>Prosopis pallida</i>). The 2 described species of <i>Carmona</i> have recently been considered conspecific and treated as <i>C. retusa</i> (Thulin 1987: 413-17). This species has been identified as <i>C. microphylla</i> (Lam .) Don [syn. <i>Elzretia microphylla</i> Lam.) in the archipelago (SL John 1973: 287). Its occurrence on Kauai represents a n ew naturalized record of <i>Carmona</i> Cav. in Hawaii." ... "Material examined. KAUAI : Kawaihau District. Wailua House Lois by Nonou Forcs1 Reserve. 49- 213 m (160 -700 ft). 28 Jan 1991. T. Flynn & M. Egan 4390 (BISH. PTBG). MAUI : Wes1 Maui, lee side of Waihee Dunes. growing under kiawe forcs1. 19 Mar 1991. R. Hobdy 3286 (BISH. US)."</p>

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	<p>Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI</p>	<p>"It readily escapes from gardens into d ry habitats and has been collected as a weedy shrub on Kaua'i, O' ahu, and Maui. Seedlings often spring up in hedgerows and shrubbery plantings around homes. Birds seem to be responsible for eating the fruit and dispersing the seeds." ... "It is proving to be invasive in the Hawaiian Islands, and gardeners should carefully monitor their plantings and remove unwanted seedlings."</p>
	<p>Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i>. http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf. [Accessed 16 Jul 2018]</p>	<p>"Seedlings and naturalized plants are also commonly observed in landscaping areas and wild semi-wild areas nearby plantings. In one area in Waiehu, <i>C. retusa</i> forms a dense shrubby understory in a kiawe (<i>Prosopis pallida</i>) forest. This plant is fairly widespread on Maui and is probably beyond the eradication stage. Future efforts should be aimed at monitoring, preventing infestations in natural areas, and educating the public about harmful plants that spread beyond the confines of the garden." ... "Invasiveness: This plant escapes from initial plantings in Hawai'i. It is capable of forming shrubby thickets in kiawe understory in Waiehu, West Maui. Plants germinate in nearby landscaping and waste areas near initial plantings. Seeds are presumed to be spread by fruit eating birds."</p>

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	<p>Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall</p>	<p>[No evidence] "References: Puerto Rico-CW-261, northern Australia and immediate northern neighbours -W-29, Africa-W-760, Global- N-85, United States of America-N-101, Pacific-E-621, Africa-N-990, Galapagos Islands-CN-1157, United States of America-Q-1197, Cuba-NI-1505, Brazil-N- 1597, Global-CD-1611, Sao Tome and Principe-N-1805, -I-, Cuba-I-2055, Cook Islands-W-1977, Cuba-W-1977, Marshall Islands-W-1977, Micronesia (Federated States of)-W-1977, Niue-W-1977, Samoa- W-1977, Global--1324."</p>

304	Environmental weed	

Qsn #	Question	Answer
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i> . http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf . [Accessed 16 Jul 2018]	[Potential environmental weed. Currently occupies waste areas] "Invasiveness: This plant escapes from initial plantings in Hawai'i. It is capable of forming shrubby thickets in kiawe understory in Waiehu, West Maui. Plants germinate in nearby landscaping and waste areas near initial plantings. Seeds are presumed to be spread by fruit eating birds."

305	Congeneric weed	y
	Source(s)	Notes
	Wells, M. J., Balsinhas, A. A., Joffe, H., Engelbrecht, V.M., Harding, G. & Stirton, C.H. (1986). A Catalogue of problem plants in Southern Africa. Botanical Research Institute, Republic of South Africa	[A native, regarded as a weed under certain circumstances] " <i>Ehretia rigida</i> ... KIND OF WEED: Agrestal (general), pastoral (natural) ... UNDESIRABLE CHARACTERISTICS: Competitive (space, light, water, nutriment), replacing preferred vegetation (grass), contaminant (seed)"
	de Padua, L.S., Bunyaphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	[Now placed in genus <i>Ehretia</i>] " <i>Carmona</i> is a monotypic genus. The only species <i>C. retusa</i> is found from India eastward to southern China, Taiwan and Japan, and further south throughout Malesia to New Guinea and the Solomon
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	<i>Ehretia acuminata</i> & <i>Ehretia cymosa</i> listed as naturalized. <i>Ehretia rigida</i> cited as a weed

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Ruengsawang, K., & Chantaranonthai, P. (2010). A revision of Boraginaceae subfamily Ehretioideae in Thailand. Thai Journal of Botany, 2(2), 113-125	[No evidence] "Shrubs or small trees 1–2 (–4) m high, branchlets terete, bark brown, hispid, brownish-tomentose, short shoots producing cluster of leaves and inflorescence. Leaves with petiole 2–8 mm long; lamina coriaceous, obovate to spatulate, 0.9–4.6 by 1.1–2.4 cm; apex toothed or crenate; base cuneate; margin recurved; upper surface dark green, lustrous, scabrous; lower surface light green, subglabrous; midrib impressed on upper surface; lateral veins in 3–4 pairs, impressed on upper surface, conspicuous on lower surface."

402	Allelopathic	n
	Source(s)	Notes
	Shinwari, M. I., Iida, O., Shinwari, M. I., & Fujii, Y. (2017). Evaluation of phytodiversity for allelopathic activity and application to minimize climate change impact: Japanese Medicinal Plants. Pakistan Journal of Botany, 49, 139-144	"In the present study, leaf litter of 160 medicinal plant samples (156 species) belonging to 134 genera and 74 families were collected from Research Center for Medicinal Plant Resources, Tanegashima, Japan and subjected to evaluation of their allelopathic effects using the Sandwich method. Lettuce (<i>Lactuca sativa</i> L.) was used as a test plant material in the bioassay because of its reliability for germination." [<i>Ehretia microphylla</i> litter did not significantly inhibit lettuce germination]

403	Parasitic	n

Qsn #	Question	Answer
	Source(s)	Notes
	Wu, Z. Y. & P. H. Raven, eds. 1995. Flora of China. Vol. 16 (Gentianaceae through Boraginaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Shrubs 1-3 m tall, much branched; bark brown; branches slender, internodes 1-2 cm, sparsely hirtellous when young; buds light brown, globose, tomentose." ... [<i>Carmona microphylla</i> = <i>Ehretia microphylla</i>]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Mukherjee, J. R., Chelladurai, V., & Ronald, J. (2011). Do Animals Eat What We Do? Observations on Medicinal Plants Used By Humans and Animals of Mundanthurai Range, Tamil Nadu. Pp. 179-196 in Kala, C. P. (ed.). Medicinal Plants and Sustainable Development. Nova Science Publishers, Inc., New York	"Table 1. Habit, distribution, abundance, medicinal plant parts used by Kani tribe, medicinal plant parts used by wild animals (as food), and endemism of 260 plant species in the Mundanthurai range of Kalakad-Mundanthurai Tiger Reserve" [Presumably palatable to deer. Leaves of <i>Ehretia microphylla</i> consumed by Chital and Sambar deer]
	Krishnamani, R. (1994). Diet composition of the bonnet macaque (<i>Macaca radiata</i>) in a tropical dry evergreen forest of southern India. <i>Tropical Biodiversity</i> , 2(2), 285-302	[Leaves consumes by macaques] "The diet composition of the bonnet macaque (<i>Macaca radiata</i>) in a tropical dry evergreen forest was studied." ... "The importance of foliar food is indicated by the fact that seven food plants were among the top 20 most frequently eaten food items: <i>Dichrostachys cinerea</i> . <i>Fluggea leucopyrus</i> , <i>Tamarindus indica</i> , <i>Ehretia microphylla</i> , <i>Manihot esculenta</i> , and <i>Abrus precatorius</i> "

405	Toxic to animals	n
	Source(s)	Notes
	Plants for a Future. (2018). <i>Carmona retusa</i> . https://pfaf.org/user/Plant.aspx?LatinName=Carmona+retusa . [Accessed 16 Jul 2018]	"Known Hazards - None known"
	Krishnamani, R. (1994). Diet composition of the bonnet macaque (<i>Macaca radiata</i>) in a tropical dry evergreen forest of southern India. <i>Tropical Biodiversity</i> , 2(2), 285-302	[No evidence. Leaves consumes by macaques] "The diet composition of the bonnet macaque (<i>Macaca radiata</i>) in a tropical dry evergreen forest was studied." ... "The importance of foliar food is indicated by the fact that seven food plants were among the top 20 most frequently eaten food items: <i>Dichrostachys cinerea</i> . <i>Fluggea leucopyrus</i> , <i>Tamarindus indica</i> , <i>Ehretia microphylla</i> , <i>Manihot esculenta</i> , and <i>Abrus precatorius</i> "
	Mukherjee, J. R., Chelladurai, V., & Ronald, J. (2011). Do Animals Eat What We Do? Observations on Medicinal Plants Used By Humans and Animals of Mundanthurai Range, Tamil Nadu. Pp. 179-196 in Kala, C. P. (ed.). Medicinal Plants and Sustainable Development. Nova Science Publishers, Inc., New York	[No evidence] "Table 1. Habit, distribution, abundance, medicinal plant parts used by Kani tribe, medicinal plant parts used by wild animals (as food), and endemism of 260 plant species in the Mundanthurai range of Kalakad-Mundanthurai Tiger Reserve" [Presumably palatable to deer. Leaves of <i>Ehretia microphylla</i> consumed by Chital and Sambar deer]
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	

Qsn #	Question	Answer
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i> . http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf . [Accessed 16 Jul 2018]	"Pests and Diseases: Caine and Zane (2001) lists the following pests and diseases. "Aphids, scale, chlorosis, mealy bugs, and snails. Red spider mites find this plant a special treat, and will attack it over any other plants in the area. Unfortunately, Fukien tea is very sensitive to insecticides, and Diazinon will kill the tree. Use the weakest insecticide possible that will address a particular problem, or if possible, employ predator insects. Will drop leaves if under-watered. Over-watering results in yellow, sickly leaves. It is quite sensitive to sudden changes in temperature and lighting."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Plants for a Future. (2018). <i>Carmona retusa</i> . https://pfaf.org/user/Plant.aspx?LatinName=Carmona+retusa . [Accessed 16 Jul 2018]	"Known Hazards - None known"
	de Padua, L.S., Bunyaphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. <i>Plant Resources of South-East Asia</i> . No 12(1). <i>Medicinal and Poisonous Plants 1</i> . Backhuys Publishers, Leiden, The Netherlands	[No evidence] "In the Philippines an infusion of the leaves of <i>C. retusa</i> is taken as a substitute for tea. It is considered stomachic, antidiarrhoeal and as a remedy for dysentery and cough. In Ternate an infusion of the leaves is taken as a febrifuge. A decoction of the leaves is taken against stomach troubles and cough in the Philippines. In Madura the roots are reported to be ingested to clean the body after childbirth. In India, the plant is considered an antidote against plant-based poisoning and an alterative in cachexia and syphilis. Furthermore, it is traditionally used to stop the haemorrhaging resulting from the bite of the viper <i>Echis carinatus</i> ."
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	[No evidence] "Used in Sidha. Antidote, febrifuge, tonic, for cough, colic, fevers, stomachache. Leaves antiinflammatory, antifungal, antibacterial, antiallergic, alterative, febrifuge, infusion against diarrhea, dysentery and cough, antidote against plant-based poisoning and viper bite; decoction for cough and stomachache; dried leaves stomachic and pectic. Leaves used a substitute for betel leaves. Veterinary medicine."

408	Creates a fire hazard in natural ecosystems	
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i> . http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf . [Accessed 16 Jul 2018]	[Unknown, but ability to form thickets in dry, fire prone areas, may contribute to fuel load & increase fire risk] "This plant escapes from initial plantings in Hawai'i. It is capable of forming shrubby thickets in kiawe understory in Waiehu, West Maui. Plants germinate in nearby landscaping and waste areas near initial plantings."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Gardino Nursery. (2018). <i>Ehretia microphylla</i> . https://www.rareflora.com/carmonami.htm . [Accessed 16 Jul 2018]	"LIGHT REQUIREMENTS : bright shade"

Qsn #	Question	Answer
	Plants for a Future. (2018). <i>Carmona retusa</i> . https://pfaf.org/user/Plant.aspx?LatinName=Carmona+retusa . [Accessed 16 Jul 2018]	"Open, dry, sunny habitats, such as thickets, shrub vegetation and teak forest at low and moderate elevations" ... "It cannot grow in the shade."
	Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i> . http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf . [Accessed 16 Jul 2018]	[Understory plant. May tolerate some shade] "It is capable of forming shrubby thickets in kiawe understory in Waiehu, West Maui."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	
	Source(s)	Notes
	Plants for a Future. (2018). <i>Carmona retusa</i> . https://pfaf.org/user/Plant.aspx?LatinName=Carmona+retusa . [Accessed 16 Jul 2018]	"Sandy soils and scrub forests"
	NParks Flora&FaunaWeb. 2018. <i>Ehretia microphylla</i> (Variegated Leaf). https://florafauanaweb.nparks.gov.sg . [Accessed 16 Jul 2018]	"Well-Drained Soils, Fertile Loamy Soils"

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Ruengsawang, K., & Chantaranothai, P. (2010). A revision of Boraginaceae subfamily Ehretioideae in Thailand. <i>Thai Journal of Botany</i> , 2(2), 113-125	"Shrubs or small trees 1–2 (–4) m high, branchlets terete, bark brown, hispid, brownish-tomentose, short shoots producing cluster of leaves and inflorescence."

412	Forms dense thickets	y
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i> . http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf . [Accessed 16 Jul 2018]	"This plant escapes from initial plantings in Hawai'i. It is capable of forming shrubby thickets in kiawe understory in Waiehu, West Maui."

501	Aquatic	n
	Source(s)	Notes
	Lorence, D.H., Flynn, T.W. & Wagner, W.L. 1995. Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. <i>Bishop Museum Occasional Papers</i> 41: 19-58	[Terrestrial] "This species is cultivated at least on Oahu and Kauai as a hedge plant. At the Kauai locality, <i>Carmona retusa</i> was collected in secondary vegetation of <i>Syzygiwn</i> , <i>Psidium</i> , <i>Leucaena</i> , and <i>Melinis</i> with forestry plantings. At the Maui site, collectors' notes indicate it is densely naturalized over several acres under kiawe (<i>Prosopis pallida</i>)."

Qsn #	Question	Answer
502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 15 Jul 2018]	"Family: Ehretiaceae" ... "Altfamily: Boraginaceae"
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 15 Jul 2018]	"Family: Ehretiaceae" ... "Altfamily: Boraginaceae"
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Ruengsawang, K., & Chantaranonthai, P. (2010). A revision of Boraginaceae subfamily Ehretioideae in Thailand. Thai Journal of Botany, 2(2), 113-125	"Shrubs or small trees 1–2 (–4) m high, branchlets terete, bark brown, hispid, brownish-tomentose, short shoots producing cluster of leaves and inflorescence."
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"C. retusa is a widespread species, and there are no reports of overexploitation. The risk of genetic erosion seems to be limited, and in addition it is cultivated as a garden ornamental."
602	Produces viable seed	y
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L.L. 2003. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 74: 23-34	"C. retusa is now also known from Hā'īku, East Maui where it can be found in lawns, along fences, and in hedges, often producing a carpet of seedlings."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"The plant is easily propagated from seed, which germinates readily, and can also be grown from cuttings."
603	Hybridizes naturally	
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Carmona is a monotypic genus. The only species C. retusa is found from India eastward to southern China, Taiwan and Japan, and further south throughout Malesia to New Guinea and the Solomon Islands." [No evidence found. Now placed in Ehretia]

Qsn #	Question	Answer
	Kadereit, J.W. & Bittrich, V. (eds.). 2016. The Families and Genera of Vascular Plants. Volume XIV. Flowering Plants. Eudicots: Aquifoliales, Boraginales, Bruniales, Dipsacales, Escalloniales, Garryales, Paracryphiales, Solanales (except Convolvulaceae), Icacinaceae, Metteniusaceae, Vahliaceae. Springer International Publishing, Switzerland	"Ehretia ... About 40 species in Old and New World tropics, with centres of diversity in Africa and East Asia."

604	Self-compatible or apomictic	
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	[Unknown. Bisexual flowers] "Flowers actinomorphic, bisexual, (4-)5-merous, pedicelled; calyx 3---6 mm long, with (4-)5 linear lobes, densely hairy inside corolla sub-rotate, white, 6-9 mm in diameter, tube about 2 mm long, widening, lobes spreading, 2.5-4.5 mm long; stamens (4-)5 with filaments 2.5-3.5 mm long and anthers oblong; ovary superior, globose, about 1 mm in diameter, style deeply bifid, 4.5-6 mm long."

605	Requires specialist pollinators	n
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Flowers actinomorphic, bisexual, (4-)5-merous, pedicelled; calyx 3 ---6 mm long, with (4-)5 linear lobes, densely hairy inside; corolla sub-rotate, white, 6-9 mm in diameter" [Small, unspecialized flowers]
	Kadereit, J.W. & Bittrich, V. (eds.). 2016. The Families and Genera of Vascular Plants. Volume XIV. Flowering Plants. Eudicots: Aquifoliales, Boraginales, Bruniales, Dipsacales, Escalloniales, Garryales, Paracryphiales, Solanales (except Convolvulaceae), Icacinaceae, Metteniusaceae, Vahliaceae. Springer International Publishing, Switzerland	"For small, white flowers of many Ehretiaceae, insects such as Hymenoptera, Diptera, Lepidoptera, Coleoptera or Thysanoptera have been recorded." [Family Description]
	Pitchandikulam Forest Virtual Herbarium. (2018). <i>Ehretia microphylla</i> - Reproduction & Dispersal. http://www.pitchandikulam-herbarium.org/contents/reproduction.php?id=45 . [Accessed 16 Jul 2018]	"Mode of pollination : <i>Ehretia microphylla</i> is pollinated by a wide variety of insects."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	[No evidence of vegetative spread] "Branch shoots are developed at every node, but are of two types: short shoots that do not elongate and long shoots that resemble the leader shoot. The fruits are reported to be dispersed by birds." ... "C. retusa can be propagated by cuttings, preferably top shoots or young leafy shoots. Roots develop slowly (1-2 months). Planting is at 1 m intervals with 2 m between rows."

607	Minimum generative time (years)	

Qsn #	Question	Answer
	Source(s)	Notes
	Talhok S.N. , Fabian M., Dagher R. 2015. Landscape Plant Database. Department of Landscape Design & Ecosystem Management, American University of Beirut. http://landscapeplant.aub.edu.lb . [Accessed 16 Jul 2018]	"Growth Rate: Moderate" ... "Height at Maturity: 3 to 5 m"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	de Padua, L.S., Bunyaphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Fruit drupaceous, globose, 5-6 mm in diameter, red or yellow, with 1-4 seeds, not breaking up into pyrenes. Seeds with a straight or slightly curved embryo, embedded in thin albumen." ... "The fruits are reported to be dispersed by birds." [No evidence. No means of external attachment]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"The leaves of <i>C. retusa</i> are used as a tea substitute in the Philippines and eastern China" ... "Fukien-tea shrub is grown as a trimmed or untrimmed hedge or sometimes as a specimen plant." ... "In Hawai'i it is grown by many Filipino and Chinese residents and also successfully grown as bonsai. It readily escapes from gardens into dry habitats and has been collected as a weedy shrub on Kaua'i, O'ahu, and Maui."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	de Padua, L.S., Bunyaphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Fruit drupaceous, globose, 5-6 mm in diameter, red or yellow, with 1-4 seeds, not breaking up into pyrenes. Seeds with a straight or slightly curved embryo, embedded in thin albumen." ... "The fruits are reported to be dispersed by birds." [No evidence]

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	de Padua, L.S., Bunyaphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Fruit drupaceous, globose, 5-6 mm in diameter, red or yellow, with 1-4 seeds, not breaking up into pyrenes. Seeds with a straight or slightly curved embryo, embedded in thin albumen." ... "The fruits are reported to be dispersed by birds."

705	Propagules water dispersed	n
	Source(s)	Notes

Qsn #	Question	Answer
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Fruit drupaceous, globose, 5-6 mm in diameter, red or yellow, with 1-4 seeds, not breaking up into pyrenes. Seeds with a straight or slightly curved embryo, embedded in thin albumen." ... "The fruits are reported to be dispersed by birds." ... "C. retusa is a rare or locally common species found in open, dry, sunny habitats, such as thickets, shrub vegetation and teak forest at low and moderate elevations." [No evidence]

706	Propagules bird dispersed	y
	Source(s)	Notes
	David, J. P., Manakadan, R., & Ganesh, T. 2015. Frugivory and seed dispersal by birds and mammals in the coastal tropical dry evergreen forests of southern India: A review. <i>Tropical Ecology</i> , 56(1): 41-55	"Appendix Table 1. Fruit traits and dispersal mode. ... Species largely dispersed by birds" [Includes <i>Carmona retusa</i>]
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Birds seem to be responsible for eating the fruit and dispersing the seeds."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Fruit drupaceous, globose, 5-6 mm in diameter, red or yellow, with 1-4 seeds, not breaking up into pyrenes. Seeds with a straight or slightly curved embryo, embedded in thin albumen." ... "The fruits are reported to be dispersed by birds." [No evidence. No means of external attachment]

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Fruit drupaceous, globose, 5-6 mm in diameter, red or yellow, with 1-4 seeds, not breaking up into pyrenes. Seeds with a straight or slightly curved embryo, embedded in thin albumen." ... "The fruits are reported to be dispersed by birds." [Presumably Yes]

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L.L. 2003. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 74: 23-34	[Possibly. Seedling carpets suggest high seed density] "C. retusa is now also known from Hā'iku, East Maui where it can be found in lawns, along fences, and in hedges, often producing a carpet of seedlings."

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Royal Botanic Gardens Kew. (2018) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/ . [Accessed 16 Jul 2018]	Unknown. Other species have orthodox seeds

803	Well controlled by herbicides	
	Source(s)	Notes
	Starr, F., Starr, K. & Loope, L. (2003). <i>Carmona retusa</i> . http://www.starrenvironmental.com/publications/species_reports/pdf/carmona_retusa.pdf . [Accessed 16 Jul 2018]	"Chemical control: According to Caine and Zane (2001), this plant is susceptible to pesticides. It would probably not be hard to kill with herbicides, using either a foliar or cut stump method." [Herbicide efficacy unknown]

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Goebel, K. (2012). Fukien Tea. (reprinted in MBS Newsletter September 2012). www.mnbonsainetwork.com/wp-content/uploads/2014/11/fukientea.pdf	[Grown as a bonsai plant. Tolerates repeated pruning] "Pruning and Wiring: The Fukien Tea, unlike most tropical/indoor bonsai, seems to grow continuously with no detectable rest period. Its normal growth is quite straight and stiff. Hard pruning the branches can be carried out at any time as long as the tree is healthy. Fukien Tea handles reduction cuts with good back budding but large cuts do not heal over. Because it has such dense foliage, it can be pruned into the desired shape without having to use a wiring technique. Use the "clip and grow" technique to give the tree dynamic movement. Prune new shoots after six to eight leaves have appeared. The leaves are tiny enough that leaf pruning should not be necessary."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates
- Naturalized on Kauai, Molokai & Maui (Hawaiian Islands)
- Invasive in secondary vegetation on Hawaiian Islands (potential environmental weed)
- Other *Ehretia* species are regarded as invasive weeds
- Tolerates some shade
- Forms thickets in understory of other trees on Maui, Hawaiian Islands
- Reproduces by seeds
- Seeds dispersed by birds & intentionally by people
- Tolerates heavy pruning (commonly used as a bonsai specimen)

Low Risk Traits

- Unarmed (no spines, thorns, or burrs)
- Palatable to deer in native range
- Non-toxic
- Used as an ornamental (bonsai) & tea substitute
- Not reported to spread vegetatively