Taxon: Morus alba L. **Family:** Moraceae

Common Name(s): Russian mulberry
silkworm mulberry
white mulberry

Synonym(s): Morus alba f. nigrobacca Moldenke
Morus alba f. tatarica (L.) Ser.
Morus atropurpurea Roxb.
Morus multicaulis Perr.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 6 May 2021

WRA Score: 11.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Naturalized Tree, Weedy Elsewhere, Mild Toxicity, Bird-Dispersed, Coppices

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	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		
303	Agricultural/forestry/horticultural weed		
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed		
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
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	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	y
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)	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	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	y=1, n=-1	y
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation		
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	y
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	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
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)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Cultivated for a long period of time, but still occurs as a wild, non-domesticated plant] "M. alba is native to China, where it is commonly found in the wild in the mountainous districts of the northern and central provinces. Its cultivation for the rearing of silkworms dates back to the dawn of Chinese civilization (Luna, 1996). It also grows wild and attains large sizes in the forests of central Yezo in Japan (Troup, 1921)."

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2021). 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**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba is sometimes found in dry temperate forests (Champion et al., 1965), but is naturalized in almost all ecological regions of the world, from boreal/temperate to subtropical/tropical arid and semiarid regions."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Climate: Given the wide geographic range of white mulberry, climate does not seem to particularly restrict its establishment. White mulberry occurs in areas with subtropical humid climates like southeastern Alabama, with long hot summers and short, mild winters [132]. It also occurs in the semiarid and continental climate of eastern Colorado, with high daily and annual temperature ranges, high potential evapotranspiration rates, and strong winds [79]. White mulberry tolerates the cold temperatures of Massachusetts, where average January temperatures are 23 °F (-5 °C) and average July temperatures are 68 °F (20 °C) [7], as well as the warm temperatures of locations like northern Alabama where average January temperatures are 45.5 °F (7.5 °C) and average July temperatures are 80.1 °F (26.7 °C) [10]. However, reports from northwestern Oklahoma indicate the tips of branches are susceptible to freezing [64], and cold winters in the Northeast killed white mulberry plantations in the 1830s (review by [106]). White mulberry tolerates a wide range of annual precipitation, occurring in areas where reported average annual precipitation ranges from 11 inches (286 mm) in central Arizona [178] to 60 inches (1,400 mm) in northern Alabama [10]."
	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	"Hardy and adaptable, mulberry is often grown in Hawai'i near sea level, although it is better suited for cooler temperatures at higher elevations."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba is sometimes found in dry temperate forests (Champion et al., 1965), but is naturalized in almost all ecological regions of the world, from boreal/temperate to subtropical/tropical arid and semiarid regions. Latitude: between 40°N and 10°S Vegetation types: dry forests Location of introductions: M. alba is commonly cultivated in many countries from sea level up to altitudes of 3300 m in the Himalayas (Watt, 1972; Gupta, 1993; Sheikh, 1993)." "Climatic amplitude (estimates) - Altitude range: 250 - 3300 m - Mean annual rainfall: 1200 - 2000 mm - Dry season duration: 2 - 4 months - Mean maximum temperature of hottest month: 21 - 37ºC - Mean minimum temperature of coldest month: 9 - 19ºC - Absolute minimum temperature: > -28ºC"
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Elevation range >1000 m] "in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m"

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. Originally cultivated for the raising of silkworms and naturalized prior to 1871 (Hillebrand, 1888). It is not entirely clear if this species is actually naturalized or only persisting; the situation should be investigated."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"It is now naturalized in many countries in Western, North and Central Asia, Eastern Africa, Europe, Central and Latin America, and the USA (Parker, 1956; Carlowitz, 1991; Siddiqui, 1993). It is more commonly seen as a planted than a wild tree throughout most of the localities of its occurrence. M. alba is sometimes found in dry temperate forests (Champion et al., 1965), but is naturalized in almost all ecological regions of the world, from boreal/temperate to subtropical/tropical arid and semiarid regions."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"It is now naturalized in many countries in Western, North and Central Asia, Eastern Africa, Europe, Central and Latin America, and the USA (Parker, 1956; Carlowitz, 1991; Siddiqui, 1993). It is more commonly seen as a planted than a wild tree throughout most of the localities of its occurrence. M. alba is sometimes found in dry temperate forests (Champion et al., 1965), but is naturalized in almost all ecological regions of the world, from boreal/temperate to subtropical/tropical arid and semiarid regions."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to China, widely cultivated and naturalized; in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i."
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 3, Fruits. Springer, New York	"White mulberry is native to central, northern China and Korea. It is widely cultivated and naturalized in many warm-temperate and subtropical regions of Asia (India, Afghanistan), Europe and America."

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. Originally cultivated for the raising of silkworms and naturalized prior to 1871 (Hillebrand, 1888). It is not entirely clear if this species is actually naturalized or only persisting; the situation should be investigated."

Qsn #	Question	Answer
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"It is now naturalized in many countries in Western, North and Central Asia, Eastern Africa, Europe, Central and Latin America, and the USA (Parker, 1956; Carlowitz, 1991; Siddiqui, 1993). It is more commonly seen as a planted than a wild tree throughout most of the localities of its occurrence. M. alba is sometimes found in dry temperate forests (Champion et al., 1965), but is naturalized in almost all ecological regions of the world, from boreal/temperate to subtropical/tropical arid and semiarid regions."
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 3, Fruits. Springer, New York	"It is widely cultivated and naturalized in many warm-temperate and subtropical regions of Asia (India, Afghanistan), Europe and America."

302	Garden/amenity/disturbance weed	
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	[A disturbance adapted tree with negative environmental impacts reported in the continental U.S., Australia and possibly elsewhere] "White mulberry establishes in disturbed [44,179,180], ruderal [25,28], and "waste" areas ([41,96,177], review by [30]), including areas along roadsides ([53,60,96,153,156], review by [30]), railroad tracks [108,168], levees [156], and near dwellings [122], and in vacant lots [168], pastures ([122,158], review by [30]), fields [45,153,168], fencerows ([28,41,44,60], review by [30]), hedgerows [144,168], or windbreaks [122]."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Establishes in disturbed sites in Hawaii. Environmental impacts have not been quantified in the Hawaiian Islands to date] "in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i."
	Bitani, N., Smith, D. A. E., Smith, Y. C. E., & Downs, C. T. (2020). Functional traits vary among fleshy-fruited invasive plant species and their potential avian dispersers. Acta Oecologica, 108, 103651	[Scored and categorized as a moderately invasive tree] "Fleshy-fruited invasive species used in this study, categorised according to the Conservation of Agricultural Resources Act (Act 43 of 1983) invading Indian Ocean Coastal Belt Forests of KwaZulu-Natal, South Africa." [Morus alba classified as Category 2 - Category 2 species may only be grown under demarcated areas and must be controlled.] "Table 2 Functional traits recorded of fleshy-fruited plant species invading Indian Ocean Coastal Belt Forests in the present study." [Morus alba with an Invasive Score = 3. The scores ranged from least invasive (= 1) to highly invasive (= 5).]

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"It is a highly invasive species in irrigated plantations and quickly spreads (Bokhari, 1973)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations, Pome Fruits"
	WRA Specialist. (2021). Personal Communication	Potential agricultural weed. Detrimental impacts to agriculture have generally not been quantified.

304	Environmental weed	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Queensland Government. (2021). Weeds of Australia. Morus alba. https://keyserver.lucidcentral.org/weeds. [Accessed 6 May 2021]	"White mulberry (Morus alba) is regarded as an environmental weed in New South Wales and Queensland. This introduced species has been widely cultivated in gardens for its fruit, and its leaves are also used to feed silkworms. It has become naturalised mainly in the warmer coastal districts of eastern Australia and is a weed of watercourses (i.e. riparian areas), native bushland, forest margins and roadsides. White mulberry (Morus alba) is ranked among the top 200 most invasive plants in south-eastern Queensland and appears on several local environmental weed lists (e.g. in Ipswich City, Redlands Shire and Caboolture Shire). It is becoming quite common along waterways in Brisbane and other parts of south-eastern Queensland (e.g. it is a priority weed in the Kedron Brook catchment in Brisbane). It is also naturalised in conservation areas and along waterways in the Sydney region (e.g. Yarramundi Reserve, Tench Reserve Riparian Corridor and Werrington Creek Riparian Corridor in the Hawkesbury River County Council area) and is of concern in north-eastern New South Wales, where it appears on some local and regional environmental weed lists (e.g. in Lismore Shire, Byron Shire and the environmental weed list for the North Coast region)."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	[Possible threat to native vegetation. Impacts generally speculative, and not quantified in this publication]] "Native vegetation: There is widespread concern over white mulberry's hybridization with the native red mulberry ([18,153,171,174], review by [30]). In Ontario, resulting hybrids were more similar to white mulberry parents, suggesting the potential for a local extinction of red mulberry [18]. In 1963, white mulberry was more common than red mulberry in southeastern Kansas [55]. There is also some concern in the mid-Atlantic region that white mulberry may transmit a harmful root disease to red mulberry [153]. Though it generally grows at relatively low densities, white mulberry has the potential to exclude native vegetation (review by [51]), particularly where it grows in dense thickets. However, as of this writing (2009) there was little published information documenting this impact. On a dredge spoil island in South Carolina, 95% of a 22.5 acre (9.1 ha) area was covered by a closed canopy, even-aged stand of white mulberry. No understory was present [120]. White mulberry also established in thickets in limestone areas in north-central Texas [32], though no impact on native vegetation was reported."
	Master Gardeners of Northern Virginia. (2021). Invasive Plant Factsheet: White Mulberry (Morus alba). https://mgnv.org. [Accessed 5 May 2021]	[Reported to displace native species] "This native of northern China was introduced in colonial times as a food source for silkworms. Although the silk industry did not succeed, the non-native tree thrived and has since spread throughout almost the entire U. S. It aggressively colonizes open areas, displacing native species, and is considered problematic in many states. Both Alexandria and Arlington list it as invasive."

305	Congeneric weed	
	Source(s)	**Notes**

Qsn #	Question	Answer
	CABI. (2021). Morus nigra. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Potentially a problem. Further research needed] "M. nigra, black mulberry, is a slow-growing, deciduous tree. The species is known to have escaped from cultivation in Denmark and Austria, is weedy in Spain, southeastern Australian bushland, and South Africa (Randall, 2012), and has been reported as invasive in southern Brazil (Gasperin and Pizo, 2009). Invasive traits include its longevity, rapid growth rate, tolerance for droughts, infertile and rocky soil, and resistance to cold, easy seed dispersal by biotic vectors attracted to its sweet, edible fruits, and repeated introductions for cultivation around the world. Considering current evidence, risk of introduction for this species is medium to high, although further research is needed."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Morus australis, Morus cathayana, Morus macroura, Morus multicaulis, Morus nigra, Morus rubra and Morus serrata listed as naturalized and/or weeds somewhere in the world. In general, negative impacts of these species have not been quantified, and further verification is needed to classify these congeners as invasive plants.

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "Shrubs or small trees up to 7 m tall, in cultivation sometimes larger; branches pubescent when young, soon glabrate. Leaves narrowly to broadly ovate, 5-18 cm long, 2-10 cm wide, sparsely pubescent at least on lower surface along principal veins, margins coarsely serrate, apex acute to acuminate, base rounded to cordate, petioles 1-3 cm long."

402	Allelopathic	
	Source(s)	**Notes**
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"The tree has been shown to exhibit allelopathic effects on Glycine max seedlings; the role of these for the invasion process has not been studied (Kumar et al., 2009)."
	Możdżeń, K., & Repka, P. (2014). Allelopathic influence of aqueous extracts from the leaves of Morus alba L. on seed germination and seedling growth of Cucumis sativus L. and Sinapsis alba L. Modern Phytomorphology, 5, 93-99	[Concentrated leaf extracts demonstrate allelopathic properties] "Abstract. The aim of the present study was to elucidate impact of the aqueous extracts from leaves of Morus alba L. on germination, growth and photosynthetic activity of Cucumis sativus L. and Sinapis alba L. Plants were grown for 21 days at the temperature 25°C (day) and 18°C (night), within 12/12 hours photoperiod, light intensity 150 µmol·m-2·s-1 and relative humidity 60-70% (day/night). Our experiments proved that allelopathic compounds in aqueous extracts of the leaves M. alba at high concentrations, reduce power and energy of germination. Biometric analysis of seedlings and adult plants grown showed that allelopathic substances have stimulating or inhibiting function depending on the stage of treatment. Moreover, they cause changes in chlorophyll contents and activity of photosystem II (PS II)."

Qsn #	Question	Answer
	Mughal, A. H. (2000). Allelopathic effect of leaf extract of Morus alba L. on germination and seedling growth of some pulses. Range Management & Agroforestry, 21(2), 164-169	[Leaf leachates demonstrate allelopathic effects] "Abstract : A laboratory experiment was conducted to study the allelopathic effect of different concentrations of leaf leachate of Morus alba on germination and seedling growth of peas (Pisum sativum), lentil (Lens culinaris) and faba beans (Vicia faba). Treatments consisted of five concentrations of leaf extracts (control, 25, 50, 75 and 100%) diluted with distilled water. In peas, maximum germination of 93% was attained with 25 and 50% concentration of leaf leachate. Maximum root length (8.1 cm), which differed significantly from the control, was obtained using 25% leachate concentration. Maximum shoot length (7.7 cm), number of secondary roots (14.4) and vigour index (1338) were all attained at 50% concentration. In lentils, germination, root length and vigour index were decreased in all allelopathin treatments compared with controls, while shoot length was similar in controls and the 25% leaf extract treatment and decreased at higher concentrations. Root length, number of secondary roots and vigour index of beans were all maximum in the 50% leachate treatment, although the difference from controls was not significant. Shoot length was significantly decreased in all leachate treatments compared with the control. Germination was 90% in controls and 100% in all leachate treatments."

403	Parasitic	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Shrubs or small trees up to 7 m tall, in cultivation sometimes larger; branches pubescent when young, soon glabrate." [Moraceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba leaf fodder is reported to be of good quality for feeding cattle, goats and sheep due to its high protein content and digestibility (Benavides, 1995). The leaves can also be used in poultry food and fish meal (Singh, 1989). On a dry matter basis, the leaves contain 15-28% crude protein, 2-8% ether extract, 9-15% crude fibre, 48-50% N-free extract, 63% total carbohydrates, 14-23% total ash, 2-5% calcium and 0.2-1.0% phosphorus (Luna, 1996), although their chemical composition usually varies with the season. Feeding experiments with sheep showed that the leaves were highly palatable and could meet their feed requirements. Left-over leaf-stalk remnants, after silkworm feeding, can reportedly be used for feeding cattle without any adverse effects on their health."

Qsn #	Question	Answer
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Palatability and/or nutritional value: Both the foliage and fruit of white mulberry are edible to livestock and wildlife. White mulberry foliage contains high levels of protein, carbohydrates, fats, fibers, vitamins and minerals (review by [20]), though a high tannin content may limit its digestibility [5]. White mulberry foliage from Pakistan contained crude protein ranging from 13.7% to 17.6% of dry mass [5]. White mulberry foliage was eaten by domestic sheep and goats in Greece (review by [86]) and was browsed by reintroduced elk in southeastern Kentucky [133]. Consumption of white mulberry foliage by silkworms is the foundation of the international silk industry ([44,168], review by [20]). Grasshoppers defoliated white mulberry foliage in Utah (review by [106])."

405	Toxic to animals	n
	Source(s)	**Notes**
	Pierce, E. (2020). Can Dogs Eat Mulberries? Central Park Paws. https://www.centralparkpaws.net/faqs/can-dogs-eat-mulberries/. [Accessed 6 May 2021]	"In most cases, yes, dogs can have mulberries. They're a natural, non-toxic berry that travels through a canine digestive system just fine."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[No evidence, but there are other reports of low toxicity or allergy to humans] "M. alba leaf fodder is reported to be of good quality for feeding cattle, goats and sheep due to its high protein content and digestibility (Benavides, 1995). The leaves can also be used in poultry food and fish meal (Singh, 1989). On a dry matter basis, the leaves contain 15-28% crude protein, 2-8% ether extract, 9-15% crude fibre, 48-50% N-free extract, 63% total carbohydrates, 14-23% total ash, 2-5% calcium and 0.2-1.0% phosphorus (Luna, 1996), although their chemical composition usually varies with the season. Feeding experiments with sheep showed that the leaves were highly palatable and could meet their feed requirements. Left-over leaf-stalk remnants, after silkworm feeding, can reportedly be used for feeding cattle without any adverse effects on their health. Cultivated varieties of M. alba yield a sweet and succulent fruit which is edible and can be processed for fruit juice, squash, wine, vinegar, etc. The leaves and stem exudates are edible."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	[Sap reportedly a skin irritant to humans, but no evidence of toxicity to animals] "Palatability and/or nutritional value: Both the foliage and fruit of white mulberry are edible to livestock and wildlife. White mulberry foliage contains high levels of protein, carbohydrates, fats, fibers, vitamins and minerals (review by [20]), though a high tannin content may limit its digestibility [5]. White mulberry foliage from Pakistan contained crude protein ranging from 13.7% to 17.6% of dry mass [5]. White mulberry foliage was eaten by domestic sheep and goats in Greece (review by [86]) and was browsed by reintroduced elk in southeastern Kentucky [133]. Consumption of white mulberry foliage by silkworms is the foundation of the international silk industry ([44,168], review by [20]). Grasshoppers defoliated white mulberry foliage in Utah (review by [106])." … "The milky sap of white mulberry is toxic to humans and irritates the skin (review by [30])."

406	Host for recognized pests and pathogens	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"M. alba can also transmit a root disease to M. rubra (ISSG, 2014)."

407	Causes allergies or is otherwise toxic to humans	y
	Source(s)	**Notes**
	The Ohio State University. (2021). Ohio Perennial and Biennial Weed Guide. http://www.oardc.ohio-state.edu/weedguide/. [Accessed 5 May 2021]	"All parts of white mulberry, except for the ripe fruit, contain a milky sap (latex) that is toxic to humans. Although humans may consume ripe mulberry fruit, ingestion of unripe fruit can result in stomach upset, stimulation of the nervous system and hallucinations. The sap is also an irritant, and contact with leaves and stems may result in varying degrees of skin irritation. White mulberry pollen is highly allergenic and contributes to hayfever."
	NC State Extension. (2021). Morus alba. https://plants.ces.ncsu.edu/plants/morus-alba/. [Accessed 5 May 2021]	"Poison Severity: Low Poison Symptoms: CAUSES ONLY LOW TOXICITY IF EATEN. Hallucinations and stomach upset from unripe berries and milky sap. Poison Toxic Principle: Unidentified Causes Contact Dermatitis: No"
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"The milky sap of white mulberry is toxic to humans and irritates the skin (review by [30])."

Qsn #	Question	Answer
408	**Creates a fire hazard in natural ecosystems**	
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	[Possibly if growing in dense thickets. Speculative] "Fuel characteristics could potentially be altered in areas where white mulberry establishes in densities and/or growth patterns differing from those of native vegetation, such as where it develops in dense thickets (e.g., see [120]). It is also possible that white mulberry alters fuel characteristics in areas where post-settlement fire exclusion facilitated the establishment of woody species like white mulberry, as was documented in riparian forests in south-central Nebraska [130] and upland areas adjacent to hardwood gallery forests in the northern Great Plains [81]. Fire regimes: It is not known what type of fire regime white mulberry is best adapted to. The current North American distribution of white mulberry includes ecosystems that historically experienced both frequent and infrequent fires of various severities. The impact of white mulberry on these fire regimes is largely unknown. One study suggests that fire exclusion in hardwood gallery forests in the northern Great Plains has facilitated spread of plants like white mulberry out of riparian corridors and into adjacent upland areas with historically high fire frequencies [81]. "

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Light: White mulberry tolerates both open and shady conditions. A review states that it cannot grow in shade [30], and a manual to woody landscaping plants reports that it tolerates full sun to light shade [33]. In Ontario, white mulberry was generally found in more open conditions than the native red mulberry [18]. White mulberry seedlings grown in experimental field plots in Nebraska had a 53% higher growth rate when grown in sun compared to shade [100]."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Able to establish in shade] "M. alba is shade-tolerant and can be grown as an understorey with strong light demanders, such as Dalbergia sissoo, in irrigated plantations in Pakistan. M. alba seedlings respond positively to shade and exhibit a very high rate of growth under it (Luna, 1996). After the sapling stage, however, the trees respond favourably to complete overhead light."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba grows on a variety of soils, ranging from alluvial sandy loams to clayey loams, but its best growth occurs on deep alluvial loamy soils with a good soil water supply and a pH of 6.0-7.5 (Gupta, 1993). In the hills, moisture availability on dry slopes is often responsible for plantation failure (Luna, 1996). Growth is not good on poorly-drained soils, particularly those with an underlying impervious pan (Hocking, 1993). M. alba does not tolerate a high degree of salinity or alkalinity."

Qsn #	Question	Answer
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 3, Fruits. Springer, New York	"White mulberry grows on wide variety of soils, but prefers a deep, well-drained soil, preferably a deep loam. Shallow soils such as those frequently found on chalk or gravel are to be avoided. Mulberries generally thrive with minimal fertilization."

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Shrubs or small trees up to 7 m tall, in cultivation sometimes larger; branches pubescent when young, soon glabrate."

412	Forms dense thickets	y
	Source(s)	**Notes**
	Keighery, G., & Longman, V. (2004). The naturalized vascular plants of Western Australia 1: Checklist, environmental weeds and distribution in IBRA regions. Plant Protection Quarterly, 19(1), 12-32	"Morus alba (Moraceae) – (SWA). Suckering and forming dense stands on cliffs above Swan River, Claremont (Keighery 13774)."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	"Successional role: While 1 review suggests that white mulberry has the potential to exclude native vegetation [51], there is little documentation of this impact occurring. White mulberry would most likely alter successional trajectories where it develops in dense thickets, a relatively infrequent establishment pattern. However, on a dredge spoil island in South Carolina, white mulberry established in a thicket so dense that understory vegetation was suppressed [120]."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence in Hawaiian Islands, unlike other areas, in spite of long history of cultivation] "in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. Originally cultivated for the raising of silkworms and naturalized prior to 1871 (Hillebrand, 1888)."

501	Aquatic	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Terrestrial] "in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m"

Qsn #	Question	Answer
502	**Grass**	**n**
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 5 May 2021]	"Family: Moraceae Tribe: Moreae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 5 May 2021]	"Family: Moraceae Tribe: Moreae"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Shrubs or small trees up to 7 m tall, in cultivation sometimes larger; branches pubescent when young, soon glabrate."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[No evidence] "M. alba is native to China, where it is commonly found in the wild in the mountainous districts of the northern and central provinces. Its cultivation for the rearing of silkworms dates back to the dawn of Chinese civilization (Luna, 1996). It also grows wild and attains large sizes in the forests of central Yezo in Japan (Troup, 1921). It is now naturalized in many countries in Western, North and Central Asia, Eastern Africa, Europe, Central and Latin America, and the USA (Parker, 1956; Carlowitz, 1991; Siddiqui, 1993). It is more commonly seen as a planted than a wild tree throughout most of the localities of its occurrence."
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 3, Fruits. Springer, New York	[No evidence] "White mulberry is native to central, northern China and Korea. It is widely cultivated and naturalized in many warm-temperate and subtropical regions of Asia (India, Afghanistan), Europe and America."

602	Produces viable seed	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba naturally regenerates profusely by seed and coppice (Hocking, 1993). Seed is dispersed by birds, water, animals and man. Seedlings easily become established under shade in irrigated plantations if the soil is not alkaline, has adequate moisture, and is free of weed growth. There is rarely any regeneration in the open." … "M. alba can be raised artificially by direct sowing, transplanting seedlings, or stump planting. There are about 430,000-460,000 seeds/kg (Ghosh, 1977). Seeds are sown in May-June in finely prepared nursery beds. Due to their small size, the seeds are mixed with ash or sawdust to ensure uniform sowing (Singh, 1989). The optimum depth of sowing is 1-5 cm. Its germinative capacity is low, 8 to 16 %, although stratification of the seeds in moist sand at about 5°C for 30-90 days improves the germination rate. Soaking the seeds in water mixed with camphor at room temperature for about a week is also reported to hasten and ensure uniform germination (Troup, 1921); some growth regulators also enhance germination of the seed (Petkov, 1995). Germination commences about one week after sowing and is completed after a further two weeks. Seedlings are kept in the nursery for 1-2 years to attain a collar diameter of 1.5-2 cm for conversion into stump plants which consist of 25 cm of root and 5 cm of shoot. Compared with other methods, stump planting gives best results (Luna, 1996)."
	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	"Mulberry is easily propagated by seeds or by cuttings taken either from shoots of the current year's growth or from older, fully woody stems."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	"Seed production: White mulberry reproduces by seed (review by [30]). In northeastern Kansas, white mulberry plants produced an average of 22.52 seeds/fruit, and fruits remained on plants an average of 3.1 days [140]."

603	Hybridizes naturally	y
	Source(s)	**Notes**
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"In eastern North America Morus alba hybridizes with the native Morus rubra; this plant species is threatened in some parts of its native range. Hybrids exert a higher fitness than M. rubra saplings, indicating the potential for replacement of the native species by hybrids and M. alba (Burgess and Husband, 2006)."
	Nepal, M., Ferguson, C., & Mayfield, M. (2015). Breeding System and Sex Ratio Variation in Mulberries (Morus, Moraceae). Journal of the Botanical Research Institute of Texas, 9(2), 383-395	"Indeed, the species constitute an interesting study system with many morphological similarities (and they sometimes hybridize; Burgess et al (2008); although they are not each other's closest relative; Nepal&: Ferguson 2012)."

604	Self-compatible or apomictic	
	Source(s)	**Notes**
	East, E. M. (1940). The distribution of self-sterility in the flowering plants. Proceedings of the American Philosophical Society 82: 449-518	"I have satisfied myself that Artocarpus communis Forst, A. integer (Thun.) Merr., Castilloa elastica Cerv., Morus alba L., and M. nigra L. are self-fertile."

Qsn #	Question	Answer
	Thabethe, V., Wilson, A. L., Hart, L. A., & Downs, C. T. (2015). Ingestion by an invasive parakeet species reduces germination success of invasive alien plants relative to ingestion by indigenous turaco species in South Africa. Biological Invasions, 17(10), 3029-3039	"Our study documents subdioecy in M. alba and M. rubra. Across 22 populations in the Flint Hills of Kansas (13 of M. alba and nine of M. rubra), the majority of the trees are consistently unisexual, but approximately 10% of the individuals are hermaphrodites." … "In the present study, both M. alba and M. rubra had some individuals that exhibited sex expression plasticity." … "Our study found similar reproductive strategies in M. alba and M. rubra in the Flint Hills region of the Great Plains: each species exhibits a subdioecious breeding system, with a male-biased sex ratio and some lability in sexual expression."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Pollination and breeding system: White mulberry is generally dioecious [18,48], though monoecious plants are occasionally found [21]. It is wind pollinated [181]."
	WRA Specialist. (2021). Personal Communication	Selfing may be possible for plants that are hermaphroditic

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Pollination and breeding system: White mulberry is generally dioecious [18,48], though monoecious plants are occasionally found [21]. It is wind pollinated [181]."
	Janick, J.& Paull, R.E. (2008). The Encyclopedia of Fruit and Nuts. CABI Publishing, Wallingford, UK	"Pollination is not usually a problem, because mulberries are wind pollinated"

606	Reproduction by vegetative fragmentation	
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Ability to sucker; regenerate rapidly; coppice; pollard"
	The Ohio State University. (2021). Ohio Perennial and Biennial Weed Guide. http://www.oardc.ohio-state.edu/weedguide/. [Accessed 5 May 2021]	"The plant has strong rooting ability and cut stems buried in soil are able to regenerate."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Vegetative regeneration: There is little evidence that white mulberry commonly regenerates vegetatively, though there are accounts of sprouting from stumps [150], roots (reviews by [21,136]), and cut stems buried in the soil (review by [30]). Stumps from 6-year-old plants of a white mulberry cultivar developed 5 to 8 sprouts that grew 16 to 20 inches (40-50 cm) in 1 year [150]."
	WRA Specialist. (2021). Personal Communication	May be able to spread locally by vegetative means if damaged, but primarily spreads by seeds

Qsn #	Question	Answer
607	**Minimum generative time (years)**	**>3**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Trees start producing viable seed after about 5 years."

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**n**
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	"Seed dispersal: White mulberry fruits are eaten and dispersed by animals, including birds ([23,71,113,121,173], review by [30]), red foxes [83], northern raccoons, Virginia opossums, squirrels [71], and other mammals (review by [30]). Box turtles may disperse white mulberry seeds [12]. Many seeds fall near the base of the parent plant [32]." [No evidence, and no means of external attachment]

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"It is now naturalized in many countries in Western, North and Central Asia, Eastern Africa, Europe, Central and Latin America, and the USA (Parker, 1956; Carlowitz, 1991; Siddiqui, 1993). It is more commonly seen as a planted than a wild tree throughout most of the localities of its occurrence."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to China, widely cultivated and naturalized; in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i."

703	**Propagules likely to disperse as a produce contaminant**	**n**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba naturally regenerates profusely by seed and coppice (Hocking, 1993). Seed is dispersed by birds, water, animals and man. Seedlings easily become established under shade in irrigated plantations if the soil is not alkaline, has adequate moisture, and is free of weed growth."

704	**Propagules adapted to wind dispersal**	**n**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Fleshy-fruit] "Syncarps white, pinkish, or purple, 1-2.5 cm long, sweet but insipid."

705	**Propagules water dispersed**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba naturally regenerates profusely by seed and coppice (Hocking, 1993). Seed is dispersed by birds, water, animals and man."

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba naturally regenerates profusely by seed and coppice (Hocking, 1993). Seed is dispersed by birds, water, animals and man. Seedlings easily become established under shade in irrigated plantations if the soil is not alkaline, has adequate moisture, and is free of weed growth. There is rarely any regeneration in the open."
	Bitani, N., Smith, D. A. E., Smith, Y. C. E., & Downs, C. T. (2020). Functional traits vary among fleshy-fruited invasive plant species and their potential avian dispersers. Acta Oecologica, 108, 103651	"Plant species like lantana (Lantana camara), Brazilian pepper tree (Schinus terebinthifolius), and white mulberry (Morus alba) are generally open habitat species characterised by smaller seed size and fruit size (<4 mm) and bird species in the Indian Ocean Coastal Belt Forests may be benefiting from these plants species and facilitating their seed dispersal."
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Seed dispersal: White mulberry fruits are eaten and dispersed by animals, including birds ([23,71,113,121,173], review by [30]), red foxes [83], northern raccoons, Virginia opossums, squirrels [71], and other mammals (review by [30]). Box turtles may disperse white mulberry seeds [12]. Many seeds fall near the base of the parent plant [32]."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Syncarps white, pinkish, or purple, 1-2.5 cm long, sweet but insipid."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	[Internally dispersed] "Seed dispersal: White mulberry fruits are eaten and dispersed by animals, including birds ([23,71,113,121,173], review by [30]), red foxes [83], northern raccoons, Virginia opossums, squirrels [71], and other mammals (review by [30]). Box turtles may disperse white mulberry seeds [12]. Many seeds fall near the base of the parent plant [32]."

Qsn #	Question	Answer
708	**Propagules survive passage through the gut**	**y**
	Source(s)	**Notes**
	Thabethe, V., Wilson, A. L., Hart, L. A., & Downs, C. T. (2015). Ingestion by an invasive parakeet species reduces germination success of invasive alien plants relative to ingestion by indigenous turaco species in South Africa. Biological Invasions, 17(10), 3029-3039	[Germination percentages vary depending on bird species consuming fruit, but in general, some seeds survive gut passage and remain viabile] "All M. alba ingested by avian species germinated after ca. 5 days (Fig. 2a), which was not significantly earlier than manually depulped seeds but significantly sooner than whole fruit seeds" … "In contrast, seeds that passed through the digestive tract of rose-ringed parakeets (i.e. M. alba and P. guajava) had significantly lower germination percentages compared with turaco ingested and manually de-pulped seeds"

801	**Prolific seed production (>1000/m2)**	**n**
	Source(s)	**Notes**
	Kalesnik, F., Sirolli, H., & Collantes, M. (2013). Seed bank composition in a secondary forest in the Lower Delta of the Paraná River (Argentina). Acta Botanica Brasilica, 27 (1), 40-49	"Table 1. Seed density in the seed bank and standing vegetation cover in four plots within a secondary forest of the Lower Delta of the Paraná River (Argentina)." [Morus alba - Germinated or counted seeds/m2 Mean = Morus alba]
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	"White mulberry seeds were detected in 32% of soil samples taken from a woodlot in southern Ontario in November, occurring in samples at a density of 334.8 seeds/m^2."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Prolific seed production, but apparently not in excess of 1000 m-2] "M. alba naturally regenerates profusely by seed and coppice (Hocking, 1993). Seed is dispersed by birds, water, animals and man. Seedlings easily become established under shade in irrigated plantations if the soil is not alkaline, has adequate moisture, and is free of weed growth. There is rarely any regeneration in the open."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 5 May 2021]	"Seed banking: A forestry handbook from India lists white mulberry seeds as viable for 720 days [111]. Tests at a nursery in Nebraska found that, while white mulberry seeds remained viable for at least a year when stored in cool, sealed conditions, they deteriorated rapidly upon removal from storage [154]. White mulberry seeds have been found in soil samples even when mature plants are not present in extant vegetation, though the seeds were not always viable. White mulberry was absent from aboveground vegetation but present at low density in the soil seed bank in deciduous forests in Bronx, New York, with viable seeds occurring at a soil depth of 0 to 4 inches (0-10 cm) [84]. White mulberry seeds were detected in 32% of soil samples taken from a woodlot in southern Ontario in November, occurring in samples at a density of 334.8 seeds/m². These seeds were not viable in seedling emergence trials [15]. In west-central Iowa, white mulberry seeds were present in the seed bank in coniferous woodland, deciduous shrub, tallgrass prairie, and midgrass prairie plant communities. Neither the viability of these seeds nor white mulberry's presence in the aboveground vegetation were reported [127]. In southeastern Arizona, white mulberry was found in the soil seed bank of a riparian deciduous forest but was not found in extant vegetation [125]."

803	Well controlled by herbicides	y
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	"Chemical control: Herbicides are effective in gaining initial control of a new invasion or a severe infestation, but they are rarely a complete or long-term solution to weed management [19]."
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Seedlings and saplings can be hand-pulled. Larger trees can be cut and the stumps ground down, or the trunks can be girdled (ISSG, 2014). Cut stumps may also be treated with a systemic herbicide such as glyphosate to prevent resprouting (Swearingen et al., 2010)."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"M. alba coppices and pollards very well at a young age, although the coppicing ability of large trees which have a diamter at breast height of greater than 30 cm is generally poor. Coppice shoots grow vigorously and attain heights of up to 5.5 m in two years."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	Stone, K.R. (2009). Morus alba. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station. https://www.fs.fed.us/database/feis/plants/tree/moralb/all.html. [Accessed 6 May 2021]	"As of this writing (2009) there were no biological control programs identified for the control of white mulberry. White mulberry is susceptible to several diseases in North America (review by [137]). In the southern United States, white mulberry may be susceptible to popcorn disease caused by the fungus Ciboria carunculoides [59]."

Qsn #	Question	Answer
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai‘i Press and Bishop Museum Press, Honolulu, HI.	[Unknown] "in Hawai'i sparingly naturalized in mesic, disturbed sites, especially in gulches, 150-1,200 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad climate suitability and elevation range
• Grows and naturalized in regions with temperate to tropical climates
• Naturalized on Kauai, Oahu, Molokai, Maui, and Hawaii (Hawaiian Islands) and widely naturalized elsewhere
• Reported to be weedy and invasive in continental North America, Australia and possibly elsewhere
• Potentially allelopathic
• Sap reportedly to be mildly toxic or allergenic to humans
• Shade tolerant
• Tolerates many soil types
• Can form dense thickets in introduced range (but impacts on other vegetation ambiguous)
• Reproduces by seeds
• Hybridizes with Morus rubra in North America
• Seeds are dispersed by birds, other frugivorous animals, water and humans
• Able to coppice and resprout after cutting

Low Risk Traits
• Does not currently appear to be negatively impacting native ecosystems or agriculture in the Hawaiian Islands, in spite of long history of cultivation in the islands, and well-documented invasiveness elsewhere in the world
• Unarmed (no spines, thorns, or burrs)
• Provides fodder for livestock
• Not reported to be toxic to animals
• Although some plants may be self-compatible, the subdioecious breeding system may reduce or prevent seed set in isolated individuals
• Herbicides provide effective control