

Taxon: <i>Salix matsudana</i> Koidz.	Family: Salicaceae
Common Name(s): Chinese willow globe willow Peking willow tortured willow	Synonym(s): <i>Salix matsudana</i> f. <i>matsudana</i> Koidz. <i>Salix matsudana</i> f. <i>tortuosa</i> Rehder <i>Salix matsudana</i> f. <i>umbraculifera</i> ...

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 8 Jan 2020
WRA Score: 5.0	Designation: EVALUATE	Rating: Evaluate

Keywords: Dioecious Tree, Naturalized Elsewhere, Hybridizes, Spreads Vegetatively, Wind-Dispersed Seeds

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)	Low
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	n
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals		
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

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
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	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)		
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
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	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m ²)		
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
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Commonly planted on plains, riverbanks. Anhui, Fujian, Gansu, Hebei, Heilongjiang, Henan, Jiangsu, Liaoning, Nei Mongol, Qinghai, Shaanxi, Sichuan, Zhejiang. A. K. Skvortsov believes that this species may be synonymous with <i>Salix babylonica</i> ."
	Stanton, B. J., Serapiglia, M. J., & Smart, L. B. (2014). The domestication and conservation of <i>Populus</i> and <i>Salix</i> genetic resources. Pp. 124-199 in <i>Poplars and Willows: Trees for Society and the Environment</i> . CAB International, Wallingford, UK	[Used in breeding programs in China] " <i>S. matsudana</i> , <i>S. babylonica</i> , <i>S. integra</i> , <i>S. suchowensis</i> , <i>S. leucopithecica</i> and <i>S. alberti</i> are native to China and feature prominently in the country's breeding programmes, along with non-natives <i>S. nigra</i> , <i>S. koreensis</i> , <i>S. purpurea</i> , <i>S. viminalis</i> and <i>S. alba</i> ."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2020). 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"	Low
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 7 Jan 2020]	"Native Asia-Temperate CHINA: China (n.e.) EASTERN ASIA: Korea"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 7 Jan 2020]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes

Qsn #	Question	Answer
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 7 Jan 2020]	"USDA hardiness zones: 4B through 8A"
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 7 Jan 2020]	"USDA hardiness: 4-8"

204	Native or naturalized in regions with tropical or subtropical climates	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 7 Jan 2020]	"Native Asia-TemperateCHINA: China (n.e.)EASTERN ASIA: Korea"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Preferred Climate/s: Mediterranean" ... "United States of America-N- 101, New Zealand-N-280, Japan-N-287, Australia-N-198, Australia-E-327, New Zealand-N-534, New Zealand-N-15, United States of America-E-151, New Zealand-N- 919, Australia-N-354, Australia-N-1049, Australia-E-1261, Australia-X-62, Ukraine- EN-1685, United States of America-E- 1736, New Zealand-N-2048, Australia-W- 1977, Romania-W-1977."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Lance, R. 2004. Woody Plants of the Southeastern United States: A Winter Guide. University of Georgia Press, Athens, GA	"A native of China; cultivated as an ornamental and occasionally naturalizing in moist soils near planted specimens through seed or shed twigs."
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Commonly planted on plains, riverbanks."
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"In the last decade there has been considerable interest in more typical <i>S. matsudana</i> . It has been widely planted in and around many towns and cities, particularly in the North Id, for soil conservation purposes and as a shelter and street tree. It is most probably becoming naturalised."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Voss, E. & Reznicek, A. A. (2012). Field Manual of Michigan Flora. University of Michigan Press, Ann Arbor, MI	"A native of China, apparently an occasional escape in moist weedy areas; first collected in 1992 by W. W. Brodowicz in Wayne Co. where apparently naturalized on a pond shore. All collections are of the cultivar "Tortuosa," the Corkscrew Willow, with contorted branches."
	Lance, R. 2004. Woody Plants of the Southeastern United States: A Winter Guide. University of Georgia Press, Athens, GA	"A native of China; cultivated as an ornamental and occasionally naturalizing in moist soils near planted specimens through seed or shed twigs."

Qsn #	Question	Answer
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"In the last decade there has been considerable interest in more typical <i>S. matsudana</i> . It has been widely planted in and around many towns and cities, particularly in the North Id, for soil conservation purposes and as a shelter and street tree. It is most probably becoming naturalised."
	Baker, M. L. (2009). The willows (<i>Salix</i> -Salicaceae) in Tasmania. <i>Muelleria</i> , 27(2), 127-148	"The tortured willow was introduced as an ornamental plant from China to Europe in the early 1920s (Bean 1980). It is naturalised in New South Wales (Jacobs & Murray 2000) and in Victoria, where it is widely cultivated and has become sparingly naturalised by vegetative means (Carr 1996). Field observations indicate that whilst this taxon is commonly cultivated throughout Tasmania, it is hardly naturalised."
	Queensland Government. (2020). Weeds of Australia. <i>Salix matsudana</i> Koidz. 'Tortuosa'. https://keyserver.lucidcentral.org . [Accessed 7 Jan 2020]	"This species is naturalised in many parts of south-eastern Australia (i.e. in the central and northern tablelands regions of New South Wales, in southern Victoria and in south-eastern South Australia). Also sparingly naturalised in the ACT."
	Malik, A. H., Dar, G. H., Khuroo, A. A., Ganie, A. H., & Munshi, A. H. (2012). <i>Salix matsudana</i> Koidzumi: a new species record for India from Kashmir Himalaya. <i>Pleione</i> 6 (1): 253-256	"While carrying out systematic studies on the genus <i>Salix</i> in the Kashmir Himalaya, one naturalized plant was collected from different localities, and after critical examination it was identified as <i>Salix matsudana</i> Koidzumi. Detailed perusal of the relevant taxonomic literature (Rehder 1927; Bailey 1963; Skvortsov 1968; Bean 1980; Kartesz 1994; Flora of China Editorial Committee 1999) revealed that this species has not so far been reported from India (Hooker 1885). The present finding is, therefore, the first record of naturalization of this species for India from the Kashmir Himalaya."

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Queensland Government. (2020). Weeds of Australia. <i>Salix matsudana</i> Koidz. 'Tortuosa'. https://keyserver.lucidcentral.org . [Accessed 8 Jan 2020]	[Classified as an environmental weed] "This species is a Class 3 Declared Plant in Queensland. Landholders are not required to control it unless their land is adjacent to an environmentally significant area. However, it is a serious offence to supply a Class 3 pest without a permit issued by the Department of Primary Industries and Fisheries. Penalties of up to \$15,000 apply. Tortured willow (<i>Salix matsudana</i> 'Tortuosa') has also been declared as a Class E Environmental Weed by the Brisbane City Council, because it is known to have damaging effects on the environment in the Brisbane area. The control objective for Class E Environmental Weeds is early detection and eradication (i.e. infestations are to be removed immediately when detected, and previously infested areas are to be monitored). Tortured willow (<i>Salix matsudana</i> 'Tortuosa') is also a Class 5 Noxious Weed in New South Wales. As such, it is a state restricted weed and its presence must be notified to the relevant local control authority (i.e. it is a notifiable weed). Class 5 Noxious Weeds also cannot be sold or purchased in this state, and they must not knowingly be moved. It is also a declared plant or noxious weed in the ACT, the Northern Territory, South Australia, Tasmania, Victoria and Western Australia."

303	Agricultural/forestry/horticultural weed	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

304	Environmental weed	y
	Source(s)	Notes
	New Zealand Plant Conservation Network. (2010). <i>Salix matsudana</i> . http://m.nzpcn.org.nz/ . [Accessed 8 Jan 2020]	"A plant that grows on riverbanks, lakesides, drainage canals and wet places (Department of Conservation 1996). A plant that forms dense stands in rivers and drains (Department of Conservation 1996). A plant that invades communities dominated by native plant species e.g. willow in manuka at Whangamarino (West 1993)."
	Queensland Government. (2020). Weeds of Australia. <i>Salix matsudana</i> Koidz. 'Tortuosa'. https://keyserver.lucidcentral.org. [Accessed 7 Jan 2020]	"This species is a Class 3 Declared Plant in Queensland. Landholders are not required to control it unless their land is adjacent to an environmentally significant area. However, it is a serious offence to supply a Class 3 pest without a permit issued by the Department of Primary Industries and Fisheries. Penalties of up to \$15,000 apply. Tortured willow (<i>Salix matsudana</i> 'Tortuosa') has also been declared as a Class E Environmental Weed by the Brisbane City Council, because it is known to have damaging effects on the environment in the Brisbane area. The control objective for Class E Environmental Weeds is early detection and eradication (i.e. infestations are to be removed immediately when detected, and previously infested areas are to be monitored). Tortured willow (<i>Salix matsudana</i> 'Tortuosa') is also a Class 5 Noxious Weed in New South Wales. As such, it is a state restricted weed and its presence must be notified to the relevant local control authority (i.e. it is a notifiable weed). Class 5 Noxious Weeds also cannot be sold or purchased in this state, and they must not knowingly be moved. It is also a declared plant or noxious weed in the ACT, the Northern Territory, South Australia, Tasmania, Victoria and Western Australia."

305	Congeneric weed	y
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	"Although willows (<i>Salix</i> spp.) are much appreciated for their various benefits, concern has grown over the past decade about their invasive natural spread in the water courses of southeastern Australia. The main environmental effects include obstruction and diversion of streams and hence erosion, extensive displacement of native vegetation with loss of biodiversity, and reductions in the quantity and quality of water. So far, only a few thousand kilometres of streams have been infested badly; that is less than 10% of potential willow habitat. Except for some of the <i>S. cinerea</i> infestations, it is still possible and worthwhile to control the willows in Australia."

Qsn #	Question	Answer
	Henderson, L. (1991). Alien invasive <i>Salix</i> spp. (willows) in the grassland biome of South Africa. <i>South African Forestry Journal</i> , 157(1), 91-95	"Roadside surveys of alien plant invaders in the grasslands of the Transvaal, Natal, Orange Free State and eastern Cape showed that several alien <i>Salix</i> species (willows) are naturalized along watercourses in these regions. <i>Salix babylonica</i> , the weeping willow, and <i>S. fragilis</i> , one of the basket willows, are the most prominent species. <i>S. babylonica</i> is the most widespread woody riverine invader in the grasslands of South Africa. <i>S. fragilis</i> (fide R.D. Meikle) is less widely distributed but prominent in the high grasslands of the northeastern Orange Free State, southern Natal and north-eastern Cape. Both species have, in places, formed pure stands along whole river reaches. Although <i>S. babylonica</i> has been planted at dams and along riverbanks its extensive occurrence along watercourses is most likely due to self (vegetative) propagation and dispersal by floodwaters. It is probable that <i>S. fragilis</i> is propagated and dispersed in the same manner. Although aesthetically pleasing and having many beneficial qualities the alien willows also pose a potential threat to the conservation of indigenous riparian species and may alter the hydrology of the watercourses they invade."
	Weber, E. 2017. <i>Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds</i> . CAB International, Wallingford, UK	[<i>Salix cinerea</i>] "The tree competes for space, water and nutrients. Stands of the tree eliminate native vegetation by shading out and accumulate sediment, which in turn alters the shape of banks, stream beds and channels."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. <i>Flora of China</i> . Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Trees to 18 m tall; trunk to 80 cm d.b.h.; bark dull grayish black, furrowed; crown broadly globose. Branchlets erect or spreading, brownish yellow or greenish, becoming brown, slender, glabrous, pilose when young. Buds slightly pubescent. Stipules when present lanceolate, margin glandular serrulate; petiole 5–8 mm, villous; leaf blade lanceolate, 5–10 × 1–1.5 cm, abaxially glaucous or slightly white, villous when young, adaxially green, shiny, base narrowly rounded, rarely cuneate, margin glandular serrulate, apex long acuminate. Male catkin cylindric, 1.5–2.5(–3) cm × 6–8 mm, ± pedunculate; bracts yellowish green, ovate, ± pubescent at base or glabrous, apex obtuse. Male flower: glands 2; stamens 2, long pubescent at base; anthers yellow. Female catkin ca. 2 cm × 4 mm, with 3–5 leaflets at base; bracts as in male catkin. Female flower: glands adaxial and abaxial or only adaxial gland present; ovary long ellipsoid, glabrous, subsessile; style almost absent; stigma ovate, lobed."

402	Allelopathic	n
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	Unknown. No mention of allelopathy contributing to invasiveness

403	Parasitic	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Trees to 18 m tall" [Salicaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Fargione, M.J., Curtis, P.O. & Richmond, M.E. (1991). Resistance of Woody Ornamental Plants to Deer Damage. Wildlife Damage Management Deer-resistant Ornamentals Fact Sheet. Cornell Cooperative Extension, Cornell University, Ithaca, NY	"Plants Seldom Severely Damaged:" [Includes <i>Salix matsudana</i> tortuosa]
	Patabendige, D., Scott, P. R., & Lefroy, E. C. (1992). Fodder trees and shrubs for high rainfall areas of south Western Australia. Report 135. Department of Agriculture and Food, Western Australia, Perth	"Table 3. Non salt tolerant species for the change of slope" [<i>Salix matsudana</i> x <i>alba</i> classified as "Very palatable"] ... "Species with edible foliage that require mechanical pruning for high production levels" [Includes <i>Salix matsudana</i>]
	Hynstrom, S. E. et al. (2009). White-tailed deer browsing and rubbing preferences for trees and shrubs that produce nontimber forest products. HortTechnology, 19 (1), 204-211	[Low levels of browsing, <20%] "We evaluated deer damage (frequency and intensity of browsing and rubbing) sustained by 26 species of trees and shrubs, the relationships among morphological features of trees and shrubs to damage levels, and the economic impacts of deer damage on the production of nontimber forest products. Levels of browsing were high (frequency >93% and intensity >50%) in most species of trees and shrubs, with the highest intensity (>60%) occurring in chinese chestnut (<i>Castanea mollissima</i>) and dogwood (<i>Cornus</i> spp.), and the lowest (<20%) in ginkgo (<i>Ginkgo biloba</i>), curly willow (<i>Salix matsudana</i>), 'Scarlet Curles' curly willow, smooth sumac (<i>Rhus glabra</i>), and pussy willow (<i>Salix caprea</i>)."
	Wilkinson, A. G. (1999). Poplars and willows for soil erosion control in New Zealand. Biomass and Bioenergy, 16(4), 263-274	[Medium palatability to possums] " <i>Salix matsudana</i> and <i>S. matsudana</i> x <i>alba</i> hybrids vary from medium to high palatability to possums while <i>Salix pentandra</i> , a slower-growing tree willow, has pro- ven less palatable."
	WRA Specialist. (2020). Personal Communication	Regarded as moderately palatable to some animals, and with possibly low palatability to deer.

405	Toxic to animals	n
	Source(s)	Notes
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 7 Jan 2020]	"Known Hazards None known"
	HerbiGuide. (2020). Willow Biology and Control. http://www.herbiguide.com.au/Descriptions/hg_willow_biology_and_control.htm . [Accessed 7 Jan 2020]	"Toxicity: May cause bloat especially if animals drink soon after eating leaves." [General description, not specifically attributed to <i>Salix matsudana</i>]
	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
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Major host of: Anoplophora glabripennis (Asian longhorned beetle); Indarbela dea (bark borer) Minor host of: Pseudodendrothrips mori (mulberry thrips); Rabdophaga saliciperda (shot-hole gall midge); Valsa sordida (valsa canker of poplar)"
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	"Pests Aphids cause deposits of honeydew on lower leaves. Spraying large trees may not be necessary as predatory insects will bring the aphid population down. Gypsy moth enjoys eating willows. Imported willow leaf beetles are metallic blue and the larvae are black. The larvae do most of the feeding on leaves. The adults eat the entire leaf while larvae skeletonize the leaves. There are two generations per year. Damage is usually not severe enough to warrant control. Lace bugs cause mottling and yellowing of the leaves. The insects are small, found under the leaves, and have transparent wings with dark veins. Poplar and willow borer in the trunk may be serious on newly planted trees. In spring the insects expel frass through openings in the trunk. The frass clings to the bark. Irrigate willows until well established. Diseases Usually none are serious enough to warrant control. Crown gall causes galls to form near the soil line or farther up the plant. Take out infected plants and do not replant in the same area for at least two years. Willow scab attacks and kills young leaves within a very short time. The fungus enters twigs, kills back the young shoots and causes cankers. Olive green spore masses can be seen along the veins on the undersides of leaves. Another fungus, Physalospora miyabeana, attacks willow and the two fungi in combination cause willow blight. Prune out infected branches and use resistant species."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 7 Jan 2020]	"Known Hazards None known"
	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

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes

Qsn #	Question	Answer
	Guo, W., Niu, S., Kang, D., Kang, W., & Wang, X. (2010). Fire-resistance of major tree species in the Beijing area. <i>Journal of Beijing Forestry University</i> , 32(3), 84-89	[Reported to have strong fire resistance] "Abstract : In this study, we selected 17 major tree species widely planted in the Beijing area in order to evaluate their fire-resistance, using principal component analysis. Four physicochemical indices (absolute moisture content, calorific value, ash content and extract content) and nine bio-ecological characteristics (phenology, crown density, leaf characteristics, bark condition, germination ability, juvenile growth rate, degree of natural pruning, ground litter structure and forest health) were investigated. The results show that the order of fire-resistance of 17 tree species from strong to weak is: <i>Ulmus pumila</i> , <i>Koelreuteria paniculata</i> , <i>Syringa amurensis</i> , <i>Salix matsudana</i> , <i>Juglans mandshurica</i> , <i>Robinia pseudoacacia</i> , <i>Populus tomentosa</i> , <i>Tilia mandshurica</i> , <i>Betula devurica</i> , <i>Celtis bungeana</i> , <i>Prunus sibirica</i> , <i>Acer truncatum</i> , <i>Quercus liaotungensis</i> , <i>Pyrus bretschneideri</i> , <i>Pinus armandii</i> , <i>Pinus tabulaeformis</i> and <i>Larix principis rupprechtii</i> . The fire-resistance of <i>Ulmus pumila</i> , <i>Koelreuteria paniculata</i> , <i>Syringa amurensis</i> , <i>Salix matsudana</i> and <i>Juglans mandshurica</i> was the strongest, in <i>Quercus liaotungensis</i> , <i>Pyrus bretschneideri</i> , <i>Pinus armandii</i> , <i>Pinus tabulaeformis</i> and <i>Larix principis-rupprechtii</i> the weakest, while <i>Robinia pseudoacacia</i> , <i>Populus tomentosa</i> , <i>Tilia mandshurica</i> , <i>Betula devurica</i> , <i>Celtis bungeana</i> and <i>Prunus sibirica</i> occupied a medium position in fire resistance."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	"Light requirement: full sun, partial sun, or partial shade"
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 8 Jan 2020]	"Succeeds in most soils, including wet, ill-drained or intermittently flooded soils[1, 11], but prefers a damp, heavy soil in a sunny position[200]."
	Dave's Garden. (2020). Corkscrew Willow, Curly Willow, Pekin Willow, Hankow Willow, Twisted-Twig Willow - <i>Salix matsudana</i> . https://davesgarden.com/guides/pf/go/54678/ . [Accessed 8 Jan 2020]	"Sun Exposure: Full Sun Sun to Partial Shade"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	"Soil tolerances: clay; sand; loam; acidic; alkaline; well drained; occasionally wet"
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 8 Jan 2020]	"Succeeds in most soils, including wet, ill-drained or intermittently flooded soils[1, 11], but prefers a damp, heavy soil in a sunny position[200]."

Qsn #	Question	Answer
411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Trees to 18 m tall; trunk to 80 cm d.b.h.; bark dull grayish black, furrowed; crown broadly globose."
412	Forms dense thickets	y
	Source(s)	Notes
	New Zealand Plant Conservation Network. (2010). <i>Salix matsudana</i> . http://m.nzpcn.org.nz/ . [Accessed 8 Jan 2020]	[Reported to form dense stands in New Zealand] "A plant that grows on riverbanks, lakesides, drainage canals and wet places (Department of Conservation 1996). A plant that forms dense stands in rivers and drains (Department of Conservation 1996). A plant that invades communities dominated by native plant species e.g. willow in manuka at Whangamarino (West 1993)."
501	Aquatic	n
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Terrestrial] "Trees to 18 m tall;" ... "Commonly planted on plains, riverbanks."
502	Grass	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 7 Jan 2020]	Family: Salicaceae
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 7 Jan 2020]	Family: Salicaceae
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Trees to 18 m tall; trunk to 80 cm d.b.h.; bark dull grayish black, furrowed; crown broadly globose."

Qsn #	Question	Answer
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Commonly planted on plains, riverbanks. Anhui, Fujian, Gansu, Hebei, Heilongjiang, Henan, Jiangsu, Liaoning, Nei Mongol, Qinghai, Shaanxi, Sichuan, Zhejiang."

602	Produces viable seed	y
	Source(s)	Notes
	Lance, R. 2004. Woody Plants of the Southeastern United States: A Winter Guide. University of Georgia Press, Athens, GA	"cultivated as an ornamental and occasionally naturalizing in moist soils near planted specimens through seed or shed twigs."
	Maroder, H. L., Prego, I. A., Facciuto, G. R., & Maldonado, S. B. (2000). Storage behaviour of <i>Salix alba</i> and <i>Salix matsudana</i> seeds. <i>Annals of Botany</i> , 86(5), 1017-1021	"Seeds from trees of <i>Salix alba</i> L. and <i>S. matsudana</i> Koidz grown in Delta area, Provincia de Buenos Aires, Argentina, were collected during mid-October 1997 using the following procedure."
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	"The tree is propagated by cuttings." [No mention of seed production. May be limited in cultivation]
	Baker, M. L. (2009). The willows (<i>Salix</i> - <i>Salicaceae</i>) in Tasmania. <i>Muelleria</i> , 27(2), 127-148	"This plant is capable of producing viable seed and seedlings through hybridisation with plants of other willow taxa."

603	Hybridizes naturally	y
	Source(s)	Notes
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 8 Jan 2020]	"Hybridizes freely with other members of this genus"
	Baker, M. L. (2009). The willows (<i>Salix</i> - <i>Salicaceae</i>) in Tasmania. <i>Muelleria</i> , 27(2), 127-148	"There is potential for some willows to reproduce and spread via both sexual and vegetative means. For example, <i>S. fragilis</i> var. <i>fragilis</i> , as mentioned above is highly adapted to spreading by fallen stems, it is also thought to have hybridised with <i>S. matsudana</i> 'Tortuosa'. ... "The occurrence of tortuose and semi-tortuose saplings, that appear to have arisen from seed, at a site in Huonville, Tasmania (Baker 1711, HO), suggests that this species can hybridise with <i>S. matsudana</i> 'Tortuosa' ... "This plant is capable of producing viable seed and seedlings through hybridisation with plants of other willow taxa."

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Stokes, K., & Cunningham, S. (2006). Predictors of Recruitment for Willows Invading Riparian Environments in South-East Australia: Implications for Weed Management. <i>Journal of Applied Ecology</i> , 43(5), 909-921	" <i>Salix</i> species are dioecious and the majority of willow introductions to Australia were single-sex, consisting largely of either weeping willow <i>Salix babylonica</i> or crack willow <i>Salix fragilis</i> ."

Qsn #	Question	Answer
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 7 Jan 2020]	"The species is dioecious (individual flowers are either male or female, but only one sex is to be found on any one plant so both male and female plants must be grown if seed is required). and is pollinated by Bees. The plant is not self-fertile."
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Family description] "Trees or shrubs, deciduous or rarely evergreen, dioecious, rarely polygamous."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Wu, Z. Y. & Raven, P. H. (eds.) 1999. Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Flowers entomophilous or anemophilous" [Genus description]
	Plants for a Future. (2020). <i>Salix matsudana</i> . https://pfaf.org/user/Plant.aspx?LatinName=Salix+matsudana . [Accessed 7 Jan 2020]	"The species is dioecious (individual flowers are either male or female, but only one sex is to be found on any one plant so both male and female plants must be grown if seed is required). and is pollinated by Bees. The plant is not self-fertile. "
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	"Willows are predominantly pollinated by insects, and perhaps partly by wind (Argus 1986). In Australia, both male and female willow flowers are highly attractive to European bees (<i>Apis</i>) as well as native bees. Although bees may fly up to 3 or 5 km to collect pollen and nectar (nectar is produced by both male and female willows), crosspollination is usually considered to be restricted to much smaller distances, such as 50 m (Free 1970). However, two sets of female willows were found to produce many viable seeds in each of two years (but not in two other years), even though the nearest compatible male was 1 km away in both cases. To be reasonably sure to prevent pollination, willow males should thus be separated from females by at least 2 km."

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Although tortured willow is mainly considered as a decorative tree for gardens, it is sometimes planted along riverbeds and lakesides where detached shoots quickly root in moist ground. Wild plants are also often found on the outskirts of towns and cities near municipal rubbish dumps."
	HerbiGuide. (2020). Willow Biology and Control. http://www.herbiguide.com.au/Descriptions/hg_willow_biology_and_control.htm . [Accessed 7 Jan 2020]	" <i>Salix matsudana</i> (New Zealand or Tortured Willow) reproduces vegetatively and will hybridise with other <i>Salix</i> species."
	CRC Weed Management. (2003). Weed Management Guide - Willow (<i>Salix</i> spp.). http://www.environment.gov.au/ . [Accessed 7 Jan 2020]	[Generic description] "Most willows spread by fragments of stems or twigs breaking off and growing new roots in water. Pieces can travel many kilometres before establishing at a new site. Fishermen often break off twigs and stick them in the riverbank to hold their lines, and these pieces will also grow."

607	Minimum generative time (years)	

Qsn #	Question	Answer
	Source(s)	Notes
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	"Growth rate: fast" [Unknown, but potentially reaches maturity quickly. A dioecious species, so both sexes would need to be present to produce seeds]
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	[Unknown for <i>S. matsudana</i>] "Flowering and the production of viable seed may begin as soon as 2 or 3 years after germination, provided that the plant is at least 1 m tall if it is a shrub willow, or 2 m tall if it is a tree willow. If growth is slower, flowering begins later and, in some taxa, flowering tends to begin at larger sizes anyway, e.g. in <i>S. alba</i> ."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Baker, M. L. (2009). The willows (<i>Salix</i> - <i>Salicaceae</i>) in Tasmania. <i>Muelleria</i> , 27(2), 127-148	"Occasionally individuals or small groups of trees grow around municipal rubbish tips from dumped garden refuse (for example at Rosebery and Queenstown)." {Spread accidentally from dumped garden waste]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Baker, M. L. (2009). The willows (<i>Salix</i> - <i>Salicaceae</i>) in Tasmania. <i>Muelleria</i> , 27(2), 127-148	"The tortured willow was introduced as an ornamental plant from China to Europe in the early 1920s (Bean 1980). It is naturalised in New South Wales (Jacobs & Murray 2000) and in Victoria, where it is widely cultivated and has become sparingly naturalised by vegetative means (Carr 1996)."
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	[Ornamental] "A small to medium-sized, upright spreading tree of about 30 feet in height with a 15-foot-spread, the main ornamental feature of this plant is the contorted and twisted branches and twigs. Branches arise from the trunk at an acute angle and grow up almost parallel to the trunk before they curve back to the horizontal. The winter branch pattern is most interesting and probably accounts for the popularity of the tree."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Stokes, K., & Cunningham, S. (2006). Predictors of Recruitment for Willows Invading Riparian Environments in South-East Australia: Implications for Weed Management. <i>Journal of Applied Ecology</i> , 43(5), 909-921	" <i>Salix</i> species are dioecious and the majority of willow introductions to Australia were single-sex, consisting largely of either weeping willow <i>Salix babylonica</i> or crack willow <i>Salix fragilis</i> ." [No evidence. Unlikely given dioecious nature of trees and lack of seed production unless both sexes are present]
	Maroder, H. L., Prego, I. A., Facciuto, G. R., & Maldonado, S. B. (2000). Storage behaviour of <i>Salix alba</i> and <i>Salix matsudana</i> seeds. <i>Annals of Botany</i> , 86(5), 1017-1021	"Willow (<i>Salix</i> spp.) seeds are short-lived. Seed viability is lost within a few days at room temperature (Teng and Yu, 1948; Arya et al., 1988) and because of this rapid loss in viability, commercial seeds are not available" [No evidence. Unlikely given short seed viability]

Qsn #	Question	Answer
704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. Biodiversity, 4(4), 17-24	"Willow seeds are highly mobile. There is no evidence for dissemination by insects or animals. Although establishment from seed transported by water is certainly possible (see above), transport by wind is far more important. The tiny seed with its fluffy parachute is superbly adapted to float even in the slightest breeze, and much of it travels for kilometres."

705	Propagules water dispersed	y
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	[Detached shoots can spread by water] "Although tortured willow is mainly considered as a decorative tree for gardens, it is sometimes planted along riverbeds and lakesides where detached shoots quickly root in moist ground. Wild plants are also often found on the outskirts of towns and cities near municipal rubbish dumps."

706	Propagules bird dispersed	n
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. Biodiversity, 4(4), 17-24	[Wind-dispersed] "Willow seeds are highly mobile. There is no evidence for dissemination by insects or animals."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. Biodiversity, 4(4), 17-24	[Wind-dispersed] "Willow seeds are highly mobile. There is no evidence for dissemination by insects or animals."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. Biodiversity, 4(4), 17-24	"Willow seeds are highly mobile. There is no evidence for dissemination by insects or animals." [Wind-dispersed. No evidence that seeds of this species, if produced, are consumed by animals]

Qsn #	Question	Answer
801	Prolific seed production (>1000/m²)	
	Source(s)	Notes
	CRC Weed Management. (2003). Weed Management Guide - Willow (<i>Salix</i> spp.). http://www.environment.gov.au/ . [Accessed 8 Jan 2020]	"Seed production is becoming more common as more willows are introduced into Australia. However, the conditions required for germination (ie continuously wet, bare sediment) do not commonly occur and the seed only remains viable for between two and six weeks, depending on the species." [Unknown for <i>Salix matsudana</i> . As a dioecious species, seed production would be limited or absent unless both sexes are present]
	Gilman, E.F. & Watson, D.G. (2006). <i>Salix matsudana</i> 'Tortuosa': Corkscrew Willow. ENH-735. Revised. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu . [Accessed 8 Jan 2020]	"The tree is propagated by cuttings." [No mention of seed production. May be limited in cultivation]

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	"In most willows, the seed lives for only 1 to 9 weeks when kept dry and at room temperature, unless it is stored at subzero temperatures (McLeod and McPherson 1973). The longevity in Australia of seed of <i>S. x rubens</i> , <i>S. nigra</i> and <i>S. cinerea</i> was found to be about 2, 3 and 6 weeks, respectively."
	Maroder, H. L., Prego, I. A., Facciuto, G. R., & Maldonado, S. B. (2000). Storage behaviour of <i>Salix alba</i> and <i>Salix matsudana</i> seeds. <i>Annals of Botany</i> , 86(5), 1017-1021	"Willow (<i>Salix</i> spp.) seeds are short-lived. Seed viability is lost within a few days at room temperature (Teng and Yu, 1948; Arya et al., 1988) and because of this rapid loss in viability, commercial seeds are not available (Brinkman, 1974)."

803	Well controlled by herbicides	y
	Source(s)	Notes
	CRC Weed Management. (2003). Weed Management Guide - Willow (<i>Salix</i> spp.). http://www.environment.gov.au/ . [Accessed 8 Jan 2020]	"Herbicides available for woody weeds are effective in controlling willow. Trees can be killed by stem injection, application to leaves and stems, bark (chemical girdling) and cut and paint methods (check with state/territory agencies for current recommendations). In dry conditions herbicide can also be applied by basal bark spraying and treatment of seedlings. Although stem injection may be a slower, more laborious method, it is an important option for avoiding chemical runoff and protecting native vegetation."
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	[Herbicides effective at controlling invasive <i>Salix</i> species] "The main method is injection of stems with the weedicide Glyphosate. Details of this and other methods are given in Cremer (1999) and in Troncone and Cremer (1997). Painting of freshly cut stems with Glyphosate is particularly effective and the spraying of foliage of shorter plants (< 2 m tall) is often effective as well."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes

Qsn #	Question	Answer
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	"Recovery after fire. Willows cope with fire surprisingly well. Where fire is able to reach the stems, the willows are easily girdled (ringbarked) by fire, because their bark is thin, unless the trunks are thick (> 40 cm). However, unless they are old, girdled willows usually produce shoots. In burnt trees, these shoots come from buried portions of the stems."
	Dave's Garden. (2020). Corkscrew Willow, Curly Willow, Pekin Willow, Hankow Willow, Twisted-Twig Willow - <i>Salix matsudana</i> . https://davesgarden.com/guides/pf/go/54678/ . [Accessed 8 Jan 2020]	[Tolerates cutting and frequent pruning] "On Aug 3, 2004, Denise in PA from Levittown, PA (Zone 6b) wrote: I took a branch from another tree and planted it in the yard and it took just fine. Accidentally, it was weed-wacked down to nothing, and surprisingly it sprouted back with with a 5 branched trunk, which made it very full and interesting. Not knowing how full and tall it would get - it is about 4 years old and 25 ft or so tall, I planted it too close to power lines and now must keep it constantly pruned"

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Cremer, K. W. (2003). Introduced willows can become invasive pests in Australia. <i>Biodiversity</i> , 4(4), 17-24	"One reason why willows may thrive in foreign lands is relative freedom there from pests and diseases. Even so, willows in Australia and New Zealand have acquired quite a few maladies (Spiers 1989), especially the leaf rust that debilitates <i>S. babylonica</i> in coastal NSW. In 1998 a voracious sawfly began defoliating various tree willows in New Zealand (van Kraayenoord, pers. comm.)."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Naturalized in Australia, New Zealand, mainland North America and elsewhere (but no evidence in the Hawaiian Islands to date)
- Designated as an environmental weed in Australia in New Zealand, impacting native biodiversity
- Other *Salix* species are invasive
- Tolerates many soil types
- Reported to form dense stands in New Zealand
- Hybridizes with other *Salix* species
- Reproduces by seeds and spreads vegetatively by stem fragments
- Seeds dispersed by wind and intentionally by people
- Spread vegetatively by water and discarded garden waste
- Tolerated repeated pruning and cutting

Low Risk Traits

- Primarily a temperate species; may limit ability to spread to upper elevations of tropical climates
- Unarmed (no spines, thorns, or burrs)
- Dioecious (requires male and female trees to produce seeds)
- Seeds lose viability quickly (will not form a persistent seed bank)
- Herbicides may provide effective control if needed

Second Screening Results for Tree/tree-like shrubs

(A) Shade tolerant or known to form dense stands?> Yes. Reported to form dense stands in New Zealand. Tolerates partial shade

(B) Bird or clearly wind-dispersed?> Seeds, if produced, dispersed by wind

(C) Life cycle <4 years? Unknown.

Outcome = Evaluate further