Weed Risk Assessment for *Toona sinensis* (A. Juss.) M. Roem. (Meliaceae) – Chinese toon/Chinese mahogany

United States Department of Agriculture

Animal and Plant Health Inspection Service

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Version 1

The image on the left is a young *Toona sinensis* grove in Autumn and was obtained from http://www.crocus.co.uk. The two images on the right reflect mature and regenerating *Toona sinensis* in a natural park setting and were obtained from http://www.rslandscapedesign2.blogspot.com.

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Introduction Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA) —specifically, the PPQ WRA model[1]—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because our WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or any area within it. We use a climate matching tool in our WRAs to evaluate those areas of the United States that are suitable for the establishment of the plant. We also use a Monte Carlo simulation to evaluate the consequences of uncertainty on the outcome of the risk assessment. For more information on the PPQ WRA process, please refer to the document, *Introduction to the PPQ Weed Risk Assessment Process*, which is available upon request.

Toona sinensis (A. Juss.) M. Roem. – Chinese toon/Chinese mahogany

Species Family: Meliaceae

Information Initiation: On November 15, 2011, Al Tasker (APHIS-PPQ) forwarded an email from the Maryland Invasive Species Council (MISC) regarding Chinese toon (*Toona sinensis*) and requested an evaluation (Tasker 2011). A Maryland resident had written the MISC about getting *T. sinensis* sprouts in their driveway from a neighbor's yard and the council suggested this could be a species of concern in Maryland.

Foreign distribution: *Toona sinensis* (synonym *Cedrela sinensis*) is native from India and Nepal eastward through China, Burma, Thailand and Malaysia to Java (Edmonds and Staniforth, 1998). It is planted in India and Sri Lanka for shade and is an important timber tree throughout southeast Asia, including Indonesia and the Philippines. This species was introduced into Europe in the mid-1800s and is cultivated in France, Germany, and England. It has been introduced into Australia, New Zealand, Japan, and other countries (Edmonds and Staniforth, 1998). It has naturalized in Japan (Mito and Uesugi 2004).

U.S. distribution and status: This species is present and has been cultivated in gardens and arboreta throughout the United States since the early 1900s (Koller, 1978). It has been in California for 100 years (Grotkopp and Rejmanek, 2007), apparently without incident. In addition to Maryland, it is said to be growing in public gardens in Massachusetts, Philadelphia, New Jersey, Illinois, New York, Ohio, and Washington, D.C. (Koller, 1978), and is also reported to be cultivated in Iowa, Kentucky, Mississippi, New York, Pennsylvania, Texas (DavesGarden, 2011), North Carolina (JCRA, 1992), Georgia (Corley et al., 2007), and California (Grotkopp and Rejmanek, 2007). It is considered "less invasive" than

[1] Koop, A., L. Fowler, L. Newton, and B. Caton. 2012. Development and validation of a weed screening tool for the United States. Biological Invasions 14(2):273-294. DOI:10.1007/s10530-011-0061-4

some other introduced tree species in California (Grotkopp and Rejmanek, 2007) and, for the same reason, has been recommended as a good alternative to *Ailanthus altissima* in Kansas (Branhagan, n.d.). It has received negative press about its invasive potential only recently, with some information available through garden forums and blogs. For example, it is being removed from a vale in Morris Park (a 147-acre woodland in Philadelphia), where it is reported as "beginning to spread at an alarming rate" (Soloman and Dijois, 2011), and is described as "an easy, potentially invasive, suckering plant" by the author Ken Druse (2011).

WRA area: Entire United States, including territories

1. *Toona sinensis* analysis

Establishment/Spread Potential

Toona sinensis is distributed well outside its native range in Asia, and relatively little evidence exists of significant spread. A paper on invasive alien species in Japan reported it as established or found in the wild, suggesting naturalization, but no further details are given (Mito and Uesugi, 2004). As mentioned above, some concern exists about its invasive potential in the United States. The traits that contribute most to its establishment/spread potential include wind-borne seed (Grotkopp and Rejmanek, 2007) and the production of clones through prolific root suckering (Zhou et al., 2010). After a mature tree is cut down, vigorous root sprouts and seedlings are produced up to 50 feet from the original tree (Brennan, 2011). We had a moderate amount of uncertainty about this element.

Risk score = 5 Uncertainty index = 0.22

Impact Potential

We found no specific evidence that *T. sinensis* is impacting natural, production, or anthropogenic systems, but it could become a pest in natural and urban areas. Due to its spreading behavior in a natural area within the City of Philadelphia, it is being eradicated by the Parks and Recreation Department (Soloman and Dijois, 2011). Root suckers and seedlings in the vicinity of the original trees are proving difficult to manage (Brennan, 2011). In South Australia, it is "not recommended" as a tree for natural areas (DECD, 1999). The risk score for this element is relatively low because of the lack of documented evidence of harm. We had a moderate amount of uncertainty with this element overall, but a high amount of uncertainty with impact potential in natural areas.

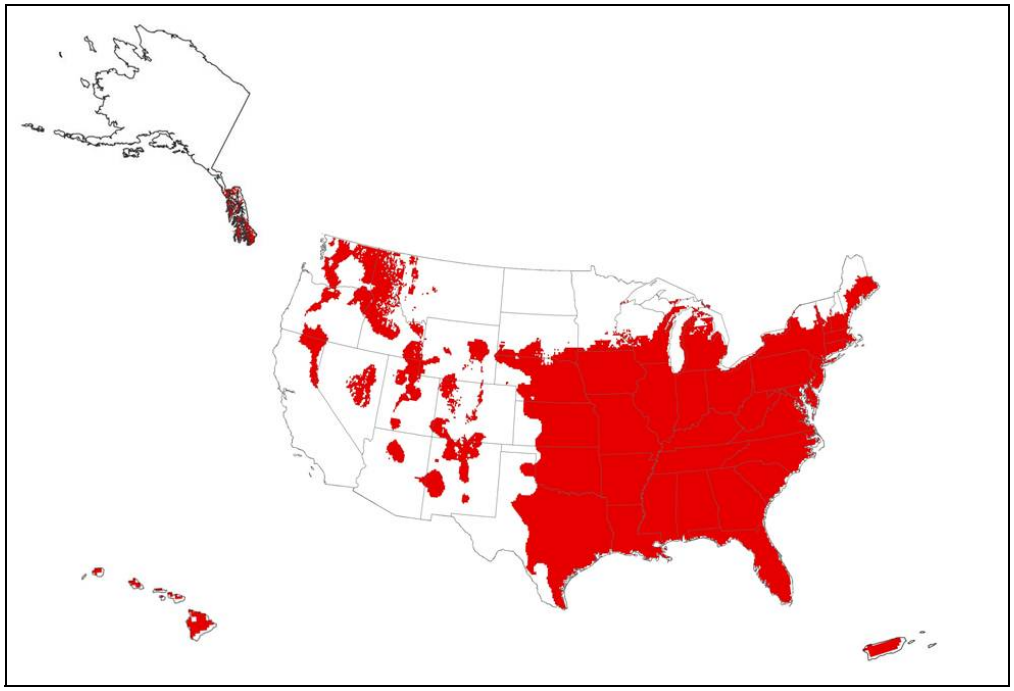
Risk score = 2.0 Uncertainty index = 0.21

Geographic Potential

Toona sinensis is widely distributed through southeastern Asia and cultivated in many parts of the world. It is the most cold-tolerant species within the genus *Toona* and can survive winter temperatures down to -20°C. While it is cultivated in many climates, it does not appear to be native or naturalized in any mediterranean climates or desert/steppe areas. We estimate that about 45 percent of the United States is suitable for the establishment of *T sinensis* (Fig. 1). The predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *T. sinensis* represents the joint distribution of Plant Hardiness Zones 5-13, areas with over10 inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savannah, humid subtropical, marine west coast, humid continental warm summers, and humid continental cool summers.

Entry Potential We did not assess this element because this species is already present in the United States (Grotkopp and Rejmanek, 2007; Soloman and Dijois, 2011; smgrowers.com, 2011; greergardens.com, 2011; Tasker, 2011; Corley et al., 2007).

Figure 1. Predicted distribution of *Toona sinensis* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



2. Results and Conclusion

Model Probabilities: P(Major Invader) = 14.8%
P(Minor Invader) = 70.4%
P(Non-Invader) = 14.9%

Risk Result = Evaluate Further

Secondary Screening = High Risk

Figure 2. *Toona sinensis* risk score (black box) relative to the risk scores of species used to develop and validate the WRA model (other symbols). See Appendix A for the complete assessment.

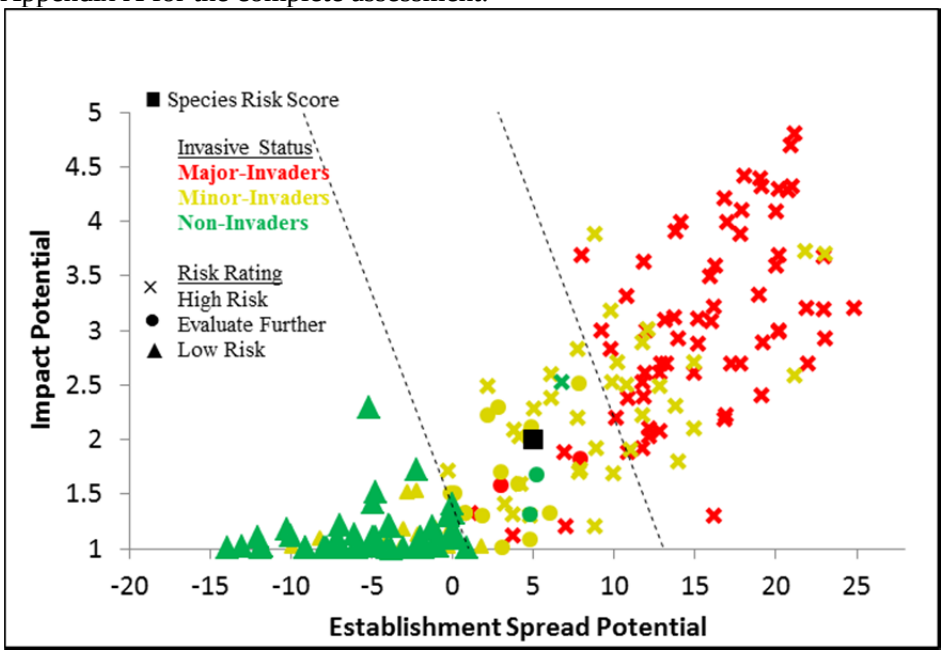
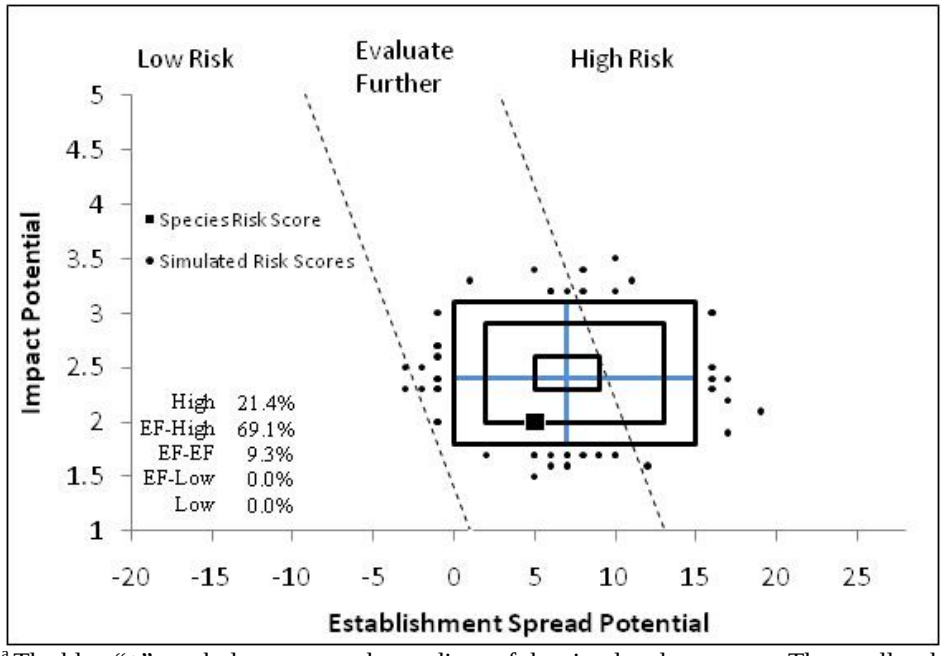


Figure 3. Monte Carlo simulation results (N=5000) for uncertainty around risk scores[a] for *Toona sinensis*.



[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of theWRA for *T. sinensis* is Evaluate Further (Fig. 2; Fig. 3); the secondary screening gives a result of High Risk. This species has been in the United States for decades and only recently have people begun to report invasive behavior. Although it has characteristics in common with many invasive trees (rapid growth, vegetative reproduction), it has not been aggressive in its introduced range and does not appear to be comparable to the similar species *Ailanthus altissima*, for example. Based on the available evidence, *T. sinensis* is likely to be a minor invader (70.4 percent probability) in natural areas and a nuisance in gardens and landscape plantings, primarily because of its tendency to produce seedlings and root suckers up to 50 feet from the parent tree.

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Appendix A. Weed risk assessment for *Toona sinensis* (A. Juss.) M. Roem. (Meliaceae). The following information was obtained from the species' risk assessment, which was conducted on a Microsoft Excel platform. The information shown below was modified to fit on the page. The original Excel file, the full questions, and the guidance to answer the questions are available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Establishment/Spread Potential			
ES-1 (Invasiveness elsewhere)	f - mod	5	Introduced into Australia (Randall, 2007). Introduced into Europe in 1862, planted in England and Paris - it remains an uncommon tree in the British Isles, restricted to botanical collections and private estates (Edmonds and Staniforth, 1998). Available in multiple nurseries in England (backyardgardener.com, 2011). Available commercially in Santa Barbara, CA (smgrowers.com, 2011) and for sale in Oregon (greergardens.com, 2011). Has been cultivated in California for at least 100 years and is not considered invasive (Grotkopp and Rejmanek, 2007). Recognized to be established or found in the wild in Japan (Mito and Uesugi, 2004). This species is said to be "spreading at an alarming rate" in Morris Park (a 147-acre woodland in Philadelphia, PA) (Soloman and Dijois, 2011). Alternate choices for the uncertainty simulation are both "e".
ES-2 (Domesticated to reduce weed potential)	n - low	0	*Toona sinensis* is a popular culinary and medicinal plant in its native range - it is gaining popularity as an edible plant (Kennedy, 2011) and a search of PubMed nets over 25 research publications, mainly focused on the cancer-fighting properties of leaf extracts (HSA, 2011). This species is used extensively as an ornamental and for timber production in agroforestry operations (Aumeeruddy and Sansonnens, 1994). 'Flamingo' is a popular cultivar for its flaming red leaves in the spring - garden sites recommend only using clones for 'Flamingo' which hints that seeds may revert to the original (green) foliage.
ES-3 (Weedy congeners)	y - negl	1	There are four species within this genus (Hua et al., 2009). *Toona ciliata* (syn. *Cedrela toona*), Australian redcedar, is widespread globally and generally accepted as invasive - it is said to invade forests, forest gaps, and riparian areas (Weber, 2003) and is listed as a potential transformer and a Category 3 (controlled) invader in South Africa (Henderson, 2001). It is also listed as invasive in four counties in the United States (Swearingen, 2010).
ES-4 (Shade Tolerance)	n - mod	0	It cannot grow in the shade (PFAF, 2011); however, a comment from the same online database states, "I have a Toon that is 15 years old and has been growing in almost complete summer shade, maybe 5% dappled sunlight, for 5 years with no sign of dying" (West Coast outside Vancouver, B.C.) (PFAF, 2011).
ES-5 (Climbing or smothering growth form)	n - negl	0	Deciduous tree to 40 m (Edmonds and Staniforth, 1998).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-6 (Dense Thickets)	? - max	0	It may become a large, single-trunked tree, but is also seen as a clump of stems to about 30 ft (9 m) high; it spreads widely by root suckers sending up slender stems to no more than 20 ft (6 m) high (Mills-Hicks, 2001). "Suckers profusely" (TAMS-ACT, n.d.). Although this species does appear to send up profuse root suckers and spread in that manner, no one has described "dense thickets." The Mid-Atlantic Invasive Plant Council offers the following information: "Five large trees were cut down within the past year (in Philadelphia), but vigorous root sprouts (and, I believe, seedlings) continue to present a challenge within 50 feet of each stump, and would quickly create a forest of young Toona trees if not routinely cut or mowed down. They are proving difficult to defeat" (Brennan, 2011). Because dense regeneration does appear to be taking place at a distance of 50 feet from the original stump and because it is unclear whether this potential "forest of young Toona trees" could be considered a dense thicket, answering "unknown" with maximum uncertainty.
ES-7 (Aquatic)	n - negl	0	Terrestrial tree--grows in light, medium or heavy soils and requires well-drained soils (PFAF, 2011).
ES-8 (Grass)	n - negl	0	Tree species within the family Meliaceae.
ES-9 (N2-fixer)	n - low	0	*Toona sinensis* is a woody plant, but species within the family Meliaceae are not known to fix nitrogen (Martin and Dowd, 1990).
ES-10 (Viable seeds)	y - low	1	Propagation is best achieved by seed (Edmonds and Staniforth, 1998).
ES-11 (Self-compatible)	? - max	0	Monoecious, with male and female flowers usually occurring in close proximity on the same inflorescence; the monoecious floral condition is now known to be complicated by a labile sexual system which results in dichogamy, polygamy, and anomalous floral development...the powerful odor which is usually associaed with Toona flowers is suggestive of insect-pollination...in the wild, Toona trees are usually found in small stands which presumably increases the opportunity for insect (and cross-) pollination (Edmonds and Staniforth, 1998).
ES-12 (Special Pollinators)	n - high	0	The powerful odor associated with Toona flowers is suggestive of insect-pollination (Edmonds and Staniforth, 1998).
ES-13 (Min generation time)	d - mod	-1	There is very little information on the biology of this species. Garden forums and blogs (e.g., Gardenweb.com, 2005) mention 4-year old trees that haven't begun to flower. Given these comments and that this species is a large tree, it is likely that it takes some time to reach sexual maturity. Alternate answers for the uncertainty simulation are "c" and "c".
ES-14 (Prolific reproduction)	? - max	0	Not clear. "They often set copious capsules, each containing innumerable seeds" (Edmonds and Staniforth, 1998). Although this would imply prolific seed

Question ID	Answer - Uncertainty	Score	Notes (and references)
			production, what the author means by "copious" and "innumerable" is not known.
ES-15 (Unintentional dispersal)	n - mod	-1	No evidence.
ES-16 (Trade contaminant)	n - mod	-1	No evidence.
ES-17 (#Natural dispersal vectors)	1 -	-2	0
ES-17a (Wind dispersal)	y - negl		Seeds are winged at one end and measure 8-16mm long, 3.5-6.2 mm broad (Edmonds and Staniforth, 1998). Wind dispersed (Grotkopp and Rejmanek, 2007).
ES-17b (Water dispersal)	n - mod		No evidence.
ES-17c (Bird dispersal)	n - mod		No evidence.
ES-17d (Animal external dispersal)	n - low		No evidence.
ES-17e (Animal internal dispersal)	n - mod		No evidence.
ES-18 (Seed bank)	n - mod	-1	There is no evidence that seeds persist for long periods; in fact, seed supply sites warn of low viability of seeds and recommend planting the seeds quickly to ensure adequate germination (agrohaitai.com, n.d.).
ES-19 (Tolerance to loss of biomass)	y - negl	1	After root injury or harvest, many "root tillering seedlings" (root suckers) are produced (Zhou et al., 2010). The species may be increased (propagated) from root cuttings (Edmonds and Staniforth, 1998). A nursery selling this species recommends digging runners or using a root barrier to prevent spread (smgrowers.com, 2011). After the removal (cutting) of mature trees, vigorous root sprouts "present a challenge within 50 feet of each stump" (Brennan, 2011).
ES-20 (Herbicide resistance)	n - low	0	No evidence - also, not listed in the database of herbicide-resistant weeds (Heap, 2011).
ES-21 (# Cold hardiness zones)	9	0	
ES-22 (# Climate types)	6	2	
ES-23 (# Precipitation bands)	10	1	
Impact Potential			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	No evidence.
Imp-G2 (Parasitic)	n - low	0	*Toona sinensis* is a tree capable of producing timber (Aumeeruddy and Sansonnens, 1994). No species within the family Meliaceae is known to be parasitic (Nickrent, 2011).
Impacts to Natural Systems			
Imp-N1 (Ecosystem processes)	n - mod	0	No evidence.
Imp-N2 (Community structure)	? - max		Unknown, as this is not addressed in the literature specific to *T. sinensis*. However, because *T. sinensis* is a tree that appears to be able to establish in a variety of soils (PFAF, 2011), and because it is currently being eradicated from a natural area in Philadelphia, PA (see question Imp-N6), there is the possibility that, given the right environment and enough time, it could alter community structure. Trees with the ability to establish populations in habitats with different soil nutrient status may alter vegetation composition, diversity patterns, and community structure (Brown et al., 2006). Invader species frequently recruit

Question ID	Answer - Uncertainty	Score	Notes (and references)
			seedlings in natural or seminatural vegetation at distances far from parent plants and most times have an effect on the community structure they establish (Vila et al., 1999).
Imp-N3 (Community composition)	? - max		Unknown, as this is not addressed in the literature specific to *T. sinensis*. However, because *T. sinensis* is a tree that spreads both vegetatively and by seed, and because this species is currently being eradicated from a natural area in Philadelphia, PA (see question Imp-N6), it would seem reasonable to conclude that it could at some point outcompete other plant species for resources. Clonal trees (including vegetative reproduction via root suckering) are among those plants with the highest risk of becoming natural area invaders (Daehler, 1998). In its native range, where it is grown for timber production, young plantations of *T. sinensis* require herbicide treatments to control weeds that may compete with *T. sinensis* (Huang and Li, 2003). Whether this is done because it is a poor competitor or whether the growers are simply trying to maximize growth potential is not known.
Imp-N4 (T&E species)	? - max		Answering unknown because the literature does not specifically address community structure and composition. However, it is certainly likely that T&E plants could be affected, given that a rapidly growing, seed bearing and vegatatively propagative tree species could be expected to outcompete other species, given the right environment and enough time.
Imp-N5 (Globally outstanding ecoregions)	? - max		Because this species may find suitable habitat through most of the United States (see analysis of geographic potential), if it becomes widely distributed in natural areas, it may affect GOE. However, because at the present time there is no evidence supporting this possibility, answering unknown with maximum uncertainty.
Imp-N6 (Natural systems weed)	c - low	0.6	This species, cited as *Cedrela sinensis*, has recently been targeted for eradication in Morris Park, a large natural area in Philadelphia, by the Parks and Recreation Department of the City of Philadelphia; the authors state that "this tree was beginning to spread at an alarming rate" (Soloman and Dijois, 2011). It is recommended as being "not suitable" for natural areas in urban planning (Australia) because of "profuse suckering" (TAMS-ACT, n.d.). Alternate answers for the uncertainty simulation are both “b”.
Impact to Anthropogenic areas (cities, suburbs, roadways)			
Imp-A1 (Affects property, civilization, ...)	n - low	0	No evidence. Answering no with low uncertainty because there is no indication that this tree possesses traits that would negatively impact these parameters.
Imp-A2 (Recreational use)	n - low	0	No evidence for any real limitations in recreation; however, the odor associated with *T. sinensis* can be extremely pungent and unpleasant, reminiscent of garlic, pepper or decomposing onions; it is characteristic of both the vegetative and floral parts of the trees and particularly

Question ID	Answer - Uncertainty	Score	Notes (and references)
			strong when the bark is slashed (Edmonds and Staniforth, 1998).
Imp-A3 (Affects ornamental plants)	? - max		No firm evidence that it outcompetes other plants. The main problem with *Toona sinensis* in garden design appears to be its propensity for suckering, which requires routine maintenance to remove the suckers (cloudforest.com, 2011). The general sense appears to be that in urban and suburban environments it's more of a nuisance plant than a truly high-impact invader.
Imp-A4 (Anthropogenic weed)	c - low	0.4	A landscaping contractor describes a project in Auckland, New Zealand in which a "very invasive" Chinese toon (*Cedrela sinensis* 'Flamingo') had taken over a residental yard and had to be entirely eradicated (HomeScape, n.d.). Multiple online garden sites describe it as needing routine maintenance to control the suckers and it is described as "an easy, potentially invasive, suckering plant" by a well-known garden author (Druse, 2011). Design standards and guidelines for the Government of South Australia state that *Cedrela sinensis* is not recommended for landscape plantings because this species "suckers too freely" (DECD, 1999). However, this species has been recommended as a viable alternative to *Ailanthus altissima* for landscape plantings in Kansas (Branhagan, n.d.).
Impact to Production systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Crop yield)	n - low	0	Fairly well-known species - no evidence that this is an agricultural weed.
Imp-P2 (Commodity Value)	n - low	0	Fairly well-known species - no evidence that this is an agricultural weed.
Imp-P3 (Affects trade)	n - low	0	Fairly well-known species - no evidence that this is an agricultural weed.
Imp-P4 (Irrigation)	n - low	0	Fairly well-known species - no evidence that this is an agricultural weed.
Imp-P5 (Animal toxicity)	n - negl	0	Young shoots and leaves cooked - a highly esteemed food in China (PFAF, 2011). Leaves and young shoots used as animal fodder in India (Edmonds and Staniforth, 1998).
Imp-P6 (Production system weed)	a - low	0	Fairly well-known species - no evidence that this is an agricultural weed. Alternate answers for the uncertainty simulation are both “b”.
Geographic Potential			
Plant cold hardiness zones			
Geo-Z1 (Zone 1)	n - low	N/A	This zone is within a Chinese province in which it is said to grow naturally (ARS-GRIN, 2011), but otherwise no evidence.
Geo-Z2 (Zone 2)	n - low	N/A	Occurrence data suggests that it can grow in this zone (China (ARS-GRIN, 2011 occ.)), however, research from its native range states that the absolute minimum temperature is -20C (Zhou et al., 2010).
Geo-Z3 (Zone 3)	n - low	N/A	Occurrence data suggests that it can grow in this zone

Question ID	Answer - Uncertainty	Score	Notes (and references)
			(China (ARS-GRIN, 2011 occ.)), however, research from its native range states that the absolute minimum temperature is -20C (Zhou et al., 2010).
Geo-Z4 (Zone 4)	n - mod	N/A	Occurrence data suggests that it can grow in this zone (China (ARS-GRIN, 2011 occ.)), however, research from its native range states that the absolute minimum temperature is -20C (Zhou et al., 2010).
Geo-Z5 (Zone 5)	y - low	N/A	South Korea (GBIF, 2011 occ.). Hardy to Zone 5 and is not frost tender (DavesGarden, 2011; Evans, n.d.; PFAF, 2011).
Geo-Z6 (Zone 6)	y - negl	N/A	South Korea (GBIF, 2011 p.s. and occ.); Japan (GBIF, 2011 occ.); USDA hardiness zones 6 to 9 (backyardgardener.com, 2011; DavesGarden, 2011; Evans, n.d.).
Geo-Z7 (Zone 7)	y - negl	N/A	Japan (GBIF, 2011 p.s.); South Korea (GBIF, 2011 occ.); USDA hardiness zones 6 to 9 (backyardgardener.com, 2011; DavesGarden, 2011; Evans, n.d.); USA - Philadelphia County, PA (Soloman and Dijois, 2011 occ.).
Geo-Z8 (Zone 8)	y - negl	N/A	France, China (Hubei, Yunnan) (GBIF, 2011 p.s.); Japan (GBIF, 2011 occ.); USDA hardiness zones 6 to 9 (backyardgardner.com 2011; Davesgarden.com 2011)
Geo-Z9 (Zone 9)	y - negl	N/A	China (Yunnan) (GBIF, 2011 p.s.); USDA hardiness zones 6 to 9 (backyardgardener.com, 2011; DavesGarden, 2011).
Geo-Z10 (Zone 10)	y - negl	N/A	Taiwan (GBIF, 2011 p.s.); Nepal (GBIF, 2011 occ.).
Geo-Z11 (Zone 11)	y - low	N/A	Thailand (GBIF, 2011 occ.).
Geo-Z12 (Zone 12)	y - low	N/A	Indonesia (Sumatera Utara), Thailand (GBIF, 2011 occ.).
Geo-Z13 (Zone 13)	y - low	N/A	Indonesia (Sumatera Utara) (GBIF, 2011 occ.).
Koppen-Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - low	N/A	Indonesia (Sumatera Utara), Malaysia (GBIF, 2011 occ.).
Geo-C2 (Tropical savanna)	y - low	N/A	Thailand (GBIF, 2011 occ.).
Geo-C3 (Steppe)	n - mod	N/A	No evidence.
Geo-C4 (Desert)	n - mod	N/A	No evidence.
Geo-C5 (Mediterranean)	n - high	N/A	No evidence that it is naturalized in a mediterranean climate.
Geo-C6 (Humid subtropical)	y - negl	N/A	China (Yunnan, Hubei), Taiwan, Japan (GBIF, 2011 p.s.); Japan, South Korea (GBIF, 2011 occ.); USA - Philadelphia County, PA (Soloman and Dijois, 2011 occ.).
Geo-C7 (Marine west coast)	y - negl	N/A	France, China (Yunnan) (GBIF, 2011 p.s.).
Geo-C8 (Humid cont. warm sum.)	y - negl	N/A	South Korea (GBIF, 2011 p.s.); Japan (GBIF, 2011 occ.); USA - Philadelphia County, PA (Soloman and Dijois, 2011 occ.).
Geo-C9 (Humid cont. cool sum.)	y - negl	N/A	India (Himachal Pradesh), Japan (GBIF, 2011 occ.)
Geo-C10 (Subarctic)	n - low	N/A	Occurrence data suggests that it can grow in this climate class (China, Bhutan (ARS-GRIN, 2011 occ.)), however, research from its native range states that the absolute minimum temperature is -20C (Zhou et al., 2010).
Geo-C11 (Tundra)	n - negl	N/A	Absolute minimum temperature is -20C Zhou et al.,

Question ID	Answer - Uncertainty	Score	Notes (and references)
			2010).
Geo-C12 (Icecap)	n - negl	N/A	Absolute minimum temperature is -20C (Zhou et al., 2010).
10-inch precipitation bands			
Geo-R1 (0-10")	n - mod	N/A	No evidence
Geo-R2 (10-20")	y - low	N/A	China (ARS-GRIN, 2011 occ.); Chengde, Hebei (China) (Yousheng and Sziklai, 1985).
Geo-R3 (20-30")	y - low	N/A	India (Himachal Pradesh) (GBIF, 2011 occ.).
Geo-R4 (30-40")	y - negl	N/A	France (GBIF, 2011 p.s.).
Geo-R5 (40-50")	y - negl	N/A	China (Yunnan, Hubei), South Korea (GBIF, 2011 p.s. & occ.), Japan (GBIF, 2011 occ.); USA - Philadelphia County, PA (Soloman and Dijois, 2011 occ.).
Geo-R6 (50-60")	y - negl	N/A	Japan (GBIF, 2011 p.s. & occ.).
Geo-R7 (60-70")	y - negl	N/A	Japan (GBIF, 2011 p.s. & occ.).
Geo-R8 (70-80")	y - negl	N/A	Taiwan (GBIF, 2011 p.s.); Japan (GBIF, 2011 occ.).
Geo-R9 (80-90")	y - high	N/A	Japan (GBIF, 2011 occ.); said to be 'intolerant of wet' (Zhou et al., 2010).
Geo-R10 (90-100")	y - high	N/A	Indonesia (Sumatera Utara) (GBIF, 2011 occ.); said to be 'intolerant to wet ' (Zhou et al., 2010).
Geo-R11 (100"+)	y - high	N/A	Indonesia (Sumatera Utara) (GBIF, 2011 occ.); said to be 'intolerant to wet ' (Zhou et al., 2010).
Entry Potential			
Ent-1 (Already here)	y - negl	1	This species has been cultivated and traded in the United States for a long time, e.g.,100 years in California (Grotkopp and Rejmanek, 2007) and only recently has begun to receive negative press (e.g., Philadelphia [Soloman and Dijois, 2011]). It is for sale in California (smgrowers.com, 2011), Oregon (greergardens.com, 2011), and growing in Maryland (Tasker, 2011). Escaped in Pennsylvania (Soloman and Dijois, 2011). Said to be growing in arboretums in Massachusetts, Pennsylvania, New Jersey, Illinois, Washington DC, New York, and Ohio (Koller, 1978). Said to be growing (in gardens) in Iowa, Kentucky, Mississippi, New York, Pennsylvania, and Texas (DavesGarden, 2011). Was acquired by the JC Ralston Arboretum in North Carolina (JCRA, 1992). Recommended as a "low maintenance" landscape plant in Georgia (Corley et al., 2007).
Ent-2 (Proposed for entry)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	
Ent-4 (Entry as a Contaminant)			
Ent-4a (In MX, CA, Central Amer., Carib., or China)	-	N/A	
Ent-4b (Propagative material)	-	N/A	
Ent-4c (Seeds)	-	N/A	
Ent-4d (Ballast water)	-	N/A	
Ent-4e (Aquaria)	-	N/A	
Ent-4f (Landscape products)	-	N/A	

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Ent-4g (Container, packing, trade goods)	-	N/A	
Ent-4h (Commodities for consumption)	-	N/A	
Ent-4i (Other pathway)	-	N/A	
Ent-5 (Natural dispersal)	-	N/A	