

Key Words: High Risk, Naturalized, Disturbance Weed, Rubber Tree, Ballistic seed dispersal

**Family:** *Euphorbiaceae*

**Taxon:** *Manihot glaziovii*

**Synonym:** *Manihot carthagenensis* subsp. *glaziovii* (Mül) **Common Name:** Ceara rubber tree  
caoutchoutier de Céara  
maniçoba-do-Ceará  
cauchotero de Ceará

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation:	H(HPWRA)
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score	8
101	Is the species highly domesticated?		y=-3, n=0		n
102	Has the species become naturalized where grown?		y=1, n=-1		
103	Does the species have weedy races?		y=1, n=-1		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
202	Quality of climate match data		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
203	Broad climate suitability (environmental versatility)		y=1, n=0		y
204	Native or naturalized in regions with tropical or subtropical climates		y=1, n=0		y
205	Does the species have a history of repeated introductions outside its natural range?		y=-2, ?=-1, n=0		y
301	Naturalized beyond native range		y = 1*multiplier (see Appendix 2), n= question 205		y
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)		y
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)		
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)		y
401	Produces spines, thorns or burrs		y=1, n=0		n
402	Allelopathic		y=1, n=0		n
403	Parasitic		y=1, n=0		n
404	Unpalatable to grazing animals		y=1, n=-1		n
405	Toxic to animals		y=1, n=0		
406	Host for recognized pests and pathogens		y=1, n=0		n
407	Causes allergies or is otherwise toxic to humans		y=1, n=0		n
408	Creates a fire hazard in natural ecosystems		y=1, n=0		n
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0		
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	n
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	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut	y=1, n=-1	
801	Prolific seed production (>1000/m2)	y=1, n=-1	
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: H(HPWRA)

WRA Score 8

## Supporting Data:

101	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Is the species highly domesticated? No] No evidence
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Species suited to tropical or subtropical climate(s) 2-High] "Native to Brazil..."
202	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Quality of climate match data 2-High]
203	1914. Brown, H.. Rubber; its sources, cultivation, and preparation. John Murray, London	[Broad climate suitability (environmental versatility)? Yes] "In most places the plants grew exceedingly well and it was soon found that the Ceara tree could be readily cultivated, as it is very hardy, a quick grower, and capable of adapting itself to very varied conditions of climate and soil." ... "In Ceylon the Ceara tree grows very freely, almost like a weed, on all kinds of soil up to elevations of 3,000 ft. and under rainfalls of 30 to 200 in. per annum. In Uganda it is being cultivated successfully at elevations of about 4,000 ft. with an average annual rainfall of 60 in. and a mean temperature of 73 F., the difference between the day and night temperature being about 30 F."
204	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Native or naturalized in regions with tropical or subtropical climates? Yes] "Native to Brazil..." ... "...in Hawaii, sparingly naturalized in moist to wet, disturbed areas in mesic to wet forest, 150-300 m, at least on Kauai, Oahu, Maui, and Hawaii. First collected on Oahu in 1919 (Garber 29, BISH)."
205	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Does the species have a history of repeated introductions outside its natural range? Yes] "Native to Brazil, widely cultivated at least in the past for rubber production;"
205	2005. Chavarriaga-Aguirre, P./Halsey, M.. Cassava ( <i>Manihot esculenta</i> Crantz): Reproductive biology and practices for confinement of experimental field trials. Report prepared for the Program for Biosafety Systems. Program for Biosafety Systems, Washington	[Does the species have a history of repeated introductions outside its natural range? Yes] "M. glaziovii is reported to be widely distributed in other parts of the tropics as well. Rogers and Appan (1973) have reported collections of it in Asia from Laos, Sri Lanka, Malaysia, Indonesia, Philippines and India, as well as from the New World tropics and islands in the Pacific Ocean."
205	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Does the species have a history of repeated introductions outside its natural range? Yes] "Beginning in 1893 it was tested in the Hawaiian Islands for its economic potential, first on Kauai, and later on Maui, Oahu, and the Big Island. Ultimately, about 1,500 acres - 1,300 of them on windward Maui - were planted with various species of rubber-producing trees, many of them Ceara trees." ... "It is doubtful that Ceara rubber tree is cultivated with any frequency today in Hawaii, but it may persist from past cultivation."
205	2008. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Does the species have a history of repeated introductions outside its natural range? Yes] "Cultivated. S Guangdong, Guangxi, Hainan [native to Brazil; widely cultivated in tropical Africa, Asia, and elsewhere]."
301	1988. Corlett, R.T.. The Naturalized Flora of Singapore. Journal of Biogeography. 15(4): 657-663.	[Naturalized beyond native range? Yes] "Appendix 1 Exotic vascular plant species naturalized in Singapore, with habit, region of origin, probable reason for introduction (orn. =as ornamental), date of first record in Singapore" [Includes <i>Manihot glaziovii</i> . Status: c = common]
301	1997. Swarbrick, J. T.. Environmental Weeds and Exotic Plants on Christmas Island, Indian Ocean: A Report to Parks Australia. J.T. Swarbrick, Weed Science Consultancy,	[Naturalized beyond native range? Yes] Naturalized in disturbed marginal rainforest. [Christmas Island]
301	1998. Paterson, R.T./Karanja, G.M./Nyaata, O.Z./Kariuki, I.W./Roothaert, R.L.. A review of tree fodder production and utilization within smallholder agroforestry systems in Kenya. Agroforestry Systems. 41: 181-199.	[Naturalized beyond native range? Yes] "This simple treatment opens the possibilities of wider utilisation of <i>Manihot glaziovii</i> , a naturalized tree in Central Kenya that is sometimes used by farmers as a source of fodder."

301	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Naturalized beyond native range? Yes] "...in Hawaii, sparingly naturalized in moist to wet, disturbed areas in mesic to wet forest, 150-300 m, at least on Kauai, Oahu, Maui, and Hawaii. First collected on Oahu in 1919 (Garber 29, BISH)."
301	2005. Chavarriaga-Aguirre, P./Halsey, M.. Cassava ( <i>Manihot esculenta</i> Crantz): Reproductive biology and practices for confinement of experimental field trials. Report prepared for the Program for Biosafety Systems. Program for Biosafety Systems, Washington	[Naturalized beyond native range? Yes] "Feral stands of cassava are reported to exist on the margins of abandoned plantations in South America, and other <i>Manihot</i> spp. are known to naturalize over time, e.g., <i>M. glaziovii</i> in Africa."
302	2007. Poon, E./Westcott, D.A./Burrows, D./Webb, A.. Assessment of research needs for the management of invasive species in the terrestrial and aquatic ecosystems of the Wet Tropics. Reef & Rainforest Research Centre Ltd, Cairns	[Garden/amenity/disturbance weed? Yes] "Table 5. High priority newly emerging environmental weeds, recommended by the WT Conservation Strategy to be eradicated completely in the WTR (WTMA 2004). (*) = WoNS." [Table includes <i>M. glaziovii</i> , but impacts are unspecified. Insufficient information to conclude this plant is an environmental weed, but enough evidence to categorize it as weedy]
302	2008. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Garden/amenity/disturbance weed? Potentially] " <i>Manihot glaziovii</i> , the Ceará rubber tree, is grown as a source of rubber. It has become naturalized in some parts of the world and is considered to be a potentially invasive weed."
302	2010. Nghiem, T.P.L. The Ecology of Invasive Tree Species in Singapore. MSc Thesis. National University of Singapore, Singapore	[Garden/amenity/disturbance weed? Potential weed of disturbed areas] "Seventeen naturalized tree species were identified from a thorough literature review, communicating with local botanists and extensive field surveys in Singapore, and nine of these were considered invasive: <i>Acacia auriculiformis</i> , <i>Cecropia pachystachya</i> , <i>Falcataria moluccana</i> , <i>Leucaena leucocephala</i> , <i>Manihot carthagensis</i> ssp. <i>glaziovii</i> , <i>Muntingia calabura</i> , <i>Piper aduncum</i> , <i>Pipturus argenteus</i> and <i>Spathodea campanulata</i> . These tree invaders were common in open sites, such as reclaimed land, wasteland, and forest fringes, but they were not found in native closed-canopied forests."
303	2007. Randall, R.P.. Global Compendium of Weeds - <i>Manihot glaziovii</i> . <a href="http://www.hear.org/gcw/species/manihot_glaziovii/">http://www.hear.org/gcw/species/manihot_glaziovii/</a>	[Agricultural/forestry/horticultural weed? No] No evidence
304	2007. Poon, E./Westcott, D.A./Burrows, D./Webb, A.. Assessment of research needs for the management of invasive species in the terrestrial and aquatic ecosystems of the Wet Tropics. Reef & Rainforest Research Centre Ltd, Cairns	[Environmental weed? Possibly] "Table 5. High priority newly emerging environmental weeds, recommended by the WT Conservation Strategy to be eradicated completely in the WTR (WTMA 2004). (*) = WoNS." [Table includes <i>M. glaziovii</i> , but impacts are unspecified]
305	2007. Nassar, N.M.A.. Wild Cassavas, <i>Manihot</i> spp. to improve the crop. Gene Conserve. 6(26): 1-13.	[Congeneric weed? Yes] "All species of the genus <i>Manihot</i> are native to South America (particularly Brazil). The only species found in other tropical regions of the world are those that have been introduced since Columbus voyages to the American continent. The species of <i>Manihot</i> are all rather sporadic in their distribution and rarely become dominant of the local vegetation. Many of these species such as <i>M. pohlilii</i> , <i>M. zehntneri</i> and <i>M. grahamii</i> are weedy types capable of invading new agitated areas, frequently are found on limestone derived and well drained soils."
305	2007. Randall, R.P.. Global Compendium of Weeds - Index. <a href="http://www.hear.org/gcw/">http://www.hear.org/gcw/</a>	[Congeneric weed? Yes] Several <i>Manihot</i> species are listed as naturalized and/or weeds
401	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Produces spines, thorns or burrs? No] "Glabrous trees 8-12 m tall. Leaves peltate, lower surface glaucous, 8-20(-30) cm long, nearly as wide, palmately 3-5-lobed, the lobes obovate to broadly elliptic, margins entire, petioles 10-25 cm long."
402	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Allelopathic? No] "Shade or shelter: It is used for temporary shade for cocoa in West Africa." ... "Soil improver: Applied as green leaf manure."
403	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Parasitic? No] "Glabrous trees 8-12 m tall." [Euphorbiaceae]

404	1998. Paterson, R.T./Karanja, G.M./Nyaata, O.Z./Kariuki, I.W./Roothaert, R.L.. A review of tree fodder production and utilization within smallholder agroforestry systems in Kenya. <i>Agroforestry Systems</i> . 41: 181–199.	[Unpalatable to grazing animals? No. Fodder Tree] "This simple treatment opens the possibilities of wider utilisation of <i>Manihot glaziovii</i> , a naturalized tree in Central Kenya that is sometimes used by farmers as a source of fodder. <i>M. glaziovii</i> has an exceptionally high CP content (Table 2) but is believed to also have high levels of HCN in the fresh
405	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Toxic to animals? Possibly under certain circumstances] "Fodder: In Senegal, young branches are fed to sheep and goats. Ceara leaves have a 25 % to 30 % dry matter protein content. However, cattle in Brazil suffer from hydrocyanic acid poisoning when they consume wilted leaves of the manicoba tree."
406	1898. Anonymous. Ceara Rubber. ( <i>Manihot Glaziovii</i> , Muell. Arg.). <i>Bulletin of Miscellaneous Information (Royal Gardens, Kew)</i> . 1898(133/134): 1-15.	[Host for recognized pests and pathogens? No] "The Ceara rubber plant is very hardy, a fast grower, free from insect and fungoid attacks, requires little or no attention when once established and thrives in poor, dry and rocky soils unsuited to almost any other crop."
406	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Host for recognized pests and pathogens? No evidence] "Other services: Used in breeding programmes, to improve disease resistance especially of cassava. Drought tolerant thus suitable for planting in the Sahel, North Africa and Brazil." ... "Older leaves are attacked by <i>Cercospora henningsii</i> Allesch in India." [No evidence that this is a significant pest]
407	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Causes allergies or is otherwise toxic to humans? No] "Food: The leaves yield a white plastic substance, which is not rubber. Hydrocyanic acid is also produced in them, but this is dissipated by heat and they are eaten cooked as a vegetable in Gabon and in East Africa. The root is rich in starch but it is hard and woody, and also produces hydrocyanic acid. It is eaten in times of food scarcity."
408	1986. Isichei, A.O./Ekeleme, F./Jimoh, B.A.. Changes in a Secondary Forest in Southwestern Nigeria Following a Ground Fire. <i>Journal of Tropical Ecology</i> . 2(3): 249-256.	[Creates a fire hazard in natural ecosystems? No evidence] " <i>Manihot glaziovii</i> , which was present in the plot and abundant in its vicinity before the fire showed a big increase in density after the fire because it was able to germinate in the openings created by the fire."
408	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Creates a fire hazard in natural ecosystems? No evidence]
409	2009. Starr, F./Starr, K.. <i>Plants of Hawaii - Manihot glaziovii</i> . <a href="http://www.hear.org/starr/images/image/?q=090623-1511&amp;o=plants">http://www.hear.org/starr/images/image/?q=090623-1511&amp;o=plants</a>	[Is a shade tolerant plant at some stage of its life cycle? Potentially Yes] " <i>Manihot glaziovii</i> ( <i>Ceara</i> rubber tree). Habit at Nahiku, Maui. June 23, 2009" [Image of plants in shaded, forest understory]
410	1914. Brown, H.. <i>Rubber; its sources, cultivation, and preparation</i> . John Murray, London	[Tolerates a wide range of soil conditions ? Yes] "In most places the plants grew exceedingly well and it was soon found that the Ceara tree could be readily cultivated, as it is very hardy, a quick grower, and capable of adapting itself to very varied conditions of climate and soil." ... "Ceara trees can be grown successfully in a moderately dry climate with a rainfall of about 40 in. per annum, but they will also do well in a humid atmosphere, with a rainfall of 100 in. or more, provided that the soil is not permanently wet. This latter point is of considerable importance in connection with the cultivation of Ceara trees, which will grow upon almost any soil except a wet one."
410	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Tolerates a wide range of soil conditions? Yes] "The tree tolerates a wide range of soils including very poor and acidic soils."
411	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. <i>Manual of the flowering plants of Hawaii</i> . Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Climbing or smothering growth habit? No] "Glabrous trees 8-12 m tall."
412	1949. Standley, P.C./Steyermark, J.A.. <i>Flora of Guatemala</i> . Part VI. Fieldiana, Botany Series. 24(6): 1-440.	[Forms dense thickets? No evidence] "Native of Brazil, but often planted in other tropical regions as a source of rubber or for shade or as a curiosity; collected near Los Verdes, Santa Rosa, in a hedge remote from dwellings, but probably planted there; sometimes cultivated in Alta Verapaz, but not commercially."
412	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. <i>Manual of the flowering plants of Hawaii</i> . Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Forms dense thickets? No evidence] "sparingly naturalized in moist to wet, disturbed areas in mesic to wet forest, 150 300 m"

501	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Aquatic? No] "Glabrous tree..." [Terrestrial]
502	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Grass? No] Euphorbiaceae
503	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Nitrogen fixing woody plant? No] Euphorbiaceae
504	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Glabrous trees 8-12 m tall. Leaves peltate, lower surface glaucous, 8-20(-30) cm long, nearly as wide, palmately 3-5-lobed, the lobes obovate to broadly elliptic, margins entire, petioles 10-25 cm long."
601	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Evidence of substantial reproductive failure in native habitat? No] No evidence
602	1914. Brown, H.. Rubber; its sources, cultivation, and preparation. John Murray, London	[Produces viable seed? Yes] "The fruit is a three-celled capsule, each cell containing a single seed ; it is nearly globular, and when ripe is hard and dry, splitting to release the seeds. The latter are plano-convex in shape and have a thick, hard seed-coat, the outer layer of which is smooth and shiny, varying in colour from grey to dark brown and mottled with purplish-black patches." ... "Manihot Glaziovii is usually propagated from seed, large quantities of which are produced by the trees at an early age."
602	2008. Wu, Z.Y./Raven,P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Produces viable seed? Yes] "Capsules subglobose or globose, ca. 2 cm in diam., warty, wingless, rugose. Seeds depressed ovoid, ca. 1.5 cm, with shallow brown spot-stripes."
602	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Produces viable seed? Yes] "M. glaziovii can be propagated either from cuttings or direct seeding."
603	2005. Chavarriaga-Aguirre, P./Halsey, M.. Cassava (Manihot esculenta Crantz): Reproductive biology and practices for confinement of experimental field trials. Report prepared for the Program for Biosafety Systems. Program for Biosafety Systems, Washington	[Hybridizes naturally? Yes] "In Africa, naturalized Manihot glaziovii (Ceara rubber tree) is the only reported relative of cassava. M. glaziovii is believed to be closely related to M. esculenta (Rogers and Appen, 1973; Second et al., 1997), and hybrids between cassava and M. glaziovii are reported to be highly fertile (Nassar, 1982). Natural hybrids with M. glaziovii from African collections have been identified and confirmed by morphological and electrophoretic markers (Wanyera et al., 1994) and DNA-based RFLP marker technique (Beeching et al., 1993). Certain African cultivars can also be identified as descendants of M. glaziovii hybrids by the same technique (ibid.). Naturally occurring hybrid stands have been reported (Lefevre, 1988). These reports reflect hybridization presumably occurring with the two species in close proximity over long periods of time; the probability of gene flow from a particular stand of cassava to M. glaziovii over specific distances and a finite time period, as would be the case with an experimental confined field trial, remains to be established."
604	2005. Nassar, N.M.A./Collevatti, R.G.. Breeding cassava for apomixis. Genetics and Molecular Research. 4 (4): :710-715.	[Self-compatible or apomictic? Yes] "Through our program of surveying apomixis in Manihot species it was discovered in the wild-cassava Manihot glaziovii."
605	2005. Chavarriaga-Aguirre, P./Halsey, M.. Cassava (Manihot esculenta Crantz): Reproductive biology and practices for confinement of experimental field trials. Report prepared for the Program for Biosafety Systems. Program for Biosafety Systems, Washington	[Requires specialist pollinators? No] "Several species of wasp (mainly Polistes spp.) and honeybees (Apis mellifera) are the main pollinators in Colombia and Africa, respectively (Kawano, 1980)." [Description of the pollinators of M. esculenta. Presumably similar insects would pollinate flowers of M. glaziovii]
605	2008. Wu, Z.Y./Raven,P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Requires specialist pollinators? No evidence] "Panicles 7–9 cm; bracts lanceolate, ca. 2.5 mm. Male flowers: calyx 9–11 mm, 5 lobed, lobes oblong, ca. 5 × 2–3 mm, apex obtuse, glabrous inside; disk shallowly cupular, 10-lobed, glabrous; anthers oblong, ca. 2.5 mm. Female flowers: calyx 10–11 mm, 5-lobed; ovary ellipsoidal, glabrous."

605	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Requires specialist pollinators? No evidence] "The flowers are freely visited by bees and the wax could be of importance."
606	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Reproduction by vegetative fragmentation? No evidence] "M. glaziovii can be propagated either from cuttings or direct seeding."
607	1898. Anonymous. Ceara Rubber. (Manihot Glaziovii, Muell. Arg.). Bulletin of Miscellaneous Information (Royal Gardens, Kew). 1898(133/134): 1-15.	[Minimum generative time (years)? 3-5] "The plant is readily propagated both from seeds and cuttings. Seeds are abundantly produced in almost every part of the world where the plant has been introduced. They may be gathered from plants when only three to five years old."
701	2008. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No evidence] "Capsules subglobose or globose, ca. 2 cm in diam., warty, wingless, rugose. Seeds depressed ovoid, ca. 1.5 cm, with shallow brown spot-stripes." [Seeds relatively large and lack means of external attachment. Could be moved in soil, but ballistic dispersal likely limits spread to vicinity of parent plants]
702	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules dispersed intentionally by people? Yes] "Ornamental: The plant is still widely grown as an ornamental."
703	2008. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Propagules likely to disperse as a produce contaminant? No evidence] "Seeds depressed-ovoid, ca. 1.5 cm, with shallow brown spot-stripes" [Unlikely, given relatively large size of seeds]
704	1986. Isichei, A.O./Ekeleme, F./Jimoh, B.A.. Changes in a Secondary Forest in Southwestern Nigeria Following a Ground Fire. Journal of Tropical Ecology. 2(3): 249-256.	[Propagules adapted to wind dispersal? No] "Manihot is not wind dispersed and its presence cannot be attributed to immigration so that most of the proliferation must have come from the soil seed bank."
704	2001. Griz, L.M.S./Machado, I.C.S.. Fruiting Phenology and Seed Dispersal Syndromes in Caatinga, a Tropical Dry Forest in the Northeast of Brazil. Journal of Tropical Ecology. 17(2): 303-321.	[Propagules adapted to wind dispersal? No. Ballistic dispersal] "Ballistic species. All euphorbs rely on ballistic dispersal through the explosive separation of their mericarps." ... "Ballistic dispersal is also related to plant height (Gottsberger & Silberbauer- Gottsberger 1983, Ridley 1930) and canopy size. It has been shown that the efficiency of ballistic dispersal is highest for plants with a crown diameter smaller than 4 m (Hughes et al. 1994). Although the crown size of Croton species, the most common ballistically dispersed genus in caatinga, were not measured here, their diameters are less than 4 m (Hughes et al. 1994). Exceptions, however, include Jatropha molissima, Manihot glaziovii and Caesalpinia pyramidales, with larger crowns."
705	1914. Brown, H.. Rubber; its sources, cultivation, and preparation. John Murray, London	[Propagules water dispersed? No evidence] "Some further observations on the natural conditions under which the Ceara tree occurs in northeastern Brazil have been published by Biffen, who visited the country in 1897. He found the tree growing well under a very wide range of conditions; on the desert plains where the annual rainfall is stated to be less than 50 in. and the vegetation is scorched for the greater part of the year, and -also on the hillsides in poor and rocky soils up to elevations of about 3,500 ft., where the rainfall is probably over 100 in. per annum and the temperature at night falls below 60 F. The tree was never found growing in marshy soil, and it appeared to thrive best in rather scanty soil amongst granite boulders."
706	2001. Griz, L.M.S./Machado, I.C.S.. Fruiting Phenology and Seed Dispersal Syndromes in Caatinga, a Tropical Dry Forest in the Northeast of Brazil. Journal of Tropical Ecology. 17(2): 303-321.	[Propagules bird dispersed? No] "Ballistic species. All euphorbs rely on ballistic dispersal through the explosive separation of their mericarps."
706	2008. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Propagules bird dispersed? No] "Capsules subglobose or globose, ca. 2 cm in diam., warty, wingless, rugose." [Not fleshy-fruited]
707	2007. Leal, I.R./Wirth, R./Tabarelli, M.. Seed Dispersal by Ants in the Semi-arid Caatinga of North-east Brazil. Annals of Botany. 99: 885-894.	[Propagules dispersed by other animals (externally)? Yes] "Table 1. Plant species with diaspores manipulated by ants on the ground in the Xingo´ region, north-east Brazil" [Includes Manihot glaziovii, which is dispersed by ants]

707	2010. Gordon, D.R./Mitterdorfer, B./Pheloung, P.C. et al.. Guidance for addressing the Australian Weed Risk Assessment questions. <i>Plant Protection Quarterly</i> . 25(2): 56-74.	[Propagules dispersed by other animals (externally)? Yes] "This dispersal group includes seeds with an oily or fat-rich outgrowth that aids in ant seed dispersal."
708	2007. Leal, I.R./Wirth, R./Tabarelli, M.. Seed Dispersal by Ants in the Semi-arid Caatinga of North-east Brazil. <i>Annals of Botany</i> . 99: 885–894.	[Propagules survive passage through the gut? Unknown, but unlikely to be consumed or dispersed internally] "Table 1. Plant species with diaspores manipulated by ants on the ground in the Xingo´ region, north-east Brazil" [Includes <i>Manihot glaziovii</i> , which is dispersed by ants]
801	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Prolific seed production (>1000/m <sup>2</sup> )? Unknown] "M. glaziovii produces many seeds which contain 90 % unsaturated oil which might possibly be used as a fuel for pre-combustion diesel engines."
802	1914. Brown, H.. <i>Rubber; its sources, cultivation, and preparation</i> . John Murray, London	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "The trees produce seed freely at an early age, and as the seeds retain their vitality for long periods the propagation of the plant is rendered easy."
802	1986. Isichei, A.O./Ekeleme, F./Jimoh, B.A.. Changes in a Secondary Forest in Southwestern Nigeria Following a Ground Fire. <i>Journal of Tropical Ecology</i> . 2(3): 249-256.	[Evidence that a persistent propagule bank is formed (>1 yr)? Possibly Yes] "Manihot is not wind dispersed and its presence cannot be attributed to immigration so that most of the proliferation must have come from the soil seed bank."
802	2002. Vozzo, J.A.. <i>Tropical Tree Seed Manual</i> . USDA Forest Service, Washington, D.C.	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "Seeds of <i>Manihot glaziovii</i> are known to be deeply dormant, possibly as a result of coat-imposed dormancy."
802	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Evidence that a persistent propagule bank is formed (>1 yr)? Possibly] "Seed storage is orthodox: dry seeds (10 %) survive 24 hrs in liquid nitrogen. Seeds tolerate desiccation to 3.7 % mc when they do not lose viability in subsequent hermitic storage at -200 deg C."
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] NO information on herbicide efficacy or chemical control of this species
804	1986. Isichei, A.O./Ekeleme, F./Jimoh, B.A.. Changes in a Secondary Forest in Southwestern Nigeria Following a Ground Fire. <i>Journal of Tropical Ecology</i> . 2(3): 249-256.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Unknown] " <i>Manihot glaziovii</i> , which was present in the plot and abundant in its vicinity before the fire showed a big increase in density after the fire because it was able to germinate in the openings created by the fire." [Plants that tolerate or benefit from such disturbance may out-compete other species. This question does not apply to seed banks.]
805	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. <i>Manual of the flowering plants of Hawaii</i> . Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown] "...in Hawaii, sparingly naturalized in moist to wet, disturbed areas in mesic to wet forest, 150 300 m, at least on Kauai, Oahu, Maui, and Hawaii. First collected on Oahu in 1919 (Garber 29, BISH)."



## **Summary of Risk Traits**

### **High Risk / Undesirable Traits**

- Naturalized in Hawaiian Islands and other locations
- Thrives in tropical climates
- Disturbance weed
- Potentially toxic under certain conditions
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Can hybridize with *M. esculenta* (Cassava)
- Apomictic
- Ballistic seed dispersal
- Seeds also ant-dispersed
- Seeds may remain dormant and form a seed bank

### **Low Risk / Desirable Traits**

- Source of rubber
- Unarmed
- Fodder tree (although potentially toxic under certain conditions)
- No evidence of vegetative spread
- Ballistic seed dispersal may limit spread to vicinity of parent trees