

Australia/New Zealand Weed Risk Assessment adapted for United States (see Gordon and Gantz 2008)

Data used for analysis published in: Gordon, D.R., K.J. Tancig, D.A. Onderdonk and C.A. Gantz. In press. Assessing the invasive potential of biofuel species proposed for Florida and the United States using the Australian weed risk assessment. Biomass and Bioenergy. doi:10.1016/j.biombioe.2010.08.029.

<i>Jatropha curcas</i> -- United States test			
	Question	Answer	Score
1.01	Is the species highly domesticated?	n	0
1.02	Has the species become naturalised where grown?		
1.03	Does the species have weedy races?		
2.01	Species suited to U.S. climates (USDA hardiness zones; 0-low, 1-intermediate, 2-high)	2	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	2	
2.03	Broad climate suitability (environmental versatility)	y	1
2.04	Native or naturalized in regions with an average of 11-60 inches of annual precipitation	y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	y	2
3.02	Garden/amenity/disturbance weed	y	2
3.03	Weed of agriculture	n	0
3.04	Environmental weed	?	
3.05	Congeneric weed	y	2
4.01	Produces spines, thorns or burrs	n	0
4.02	Allelopathic		
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	y	1
4.05	Toxic to animals	y	1
4.06	Host for recognised pests and pathogens	?	
4.07	Causes allergies or is otherwise toxic to humans	y	1
4.08	Creates a fire hazard in natural ecosystems		

4.09	Is a shade tolerant plant at some stage of its life cycle	n	0
4.10	Grows on one or more of the following soil types: alfisols, entisols, or mollisols	y	1
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets	y	1
5.01	Aquatic	n	0
5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat	n	0
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally	y	1
6.04	Self-compatible or apomictic	y	1
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative fragmentation	y	1
6.07	Minimum generative time (years)	1	1
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	?	
7.02	Propagules dispersed intentionally by people	y	1
7.03	Propagules likely to disperse as a produce contaminant	n	-1
7.04	Propagules adapted to wind dispersal	n	-1
7.05	Propagules water dispersed	y	1
7.06	Propagules bird dispersed		
7.07	Propagules dispersed by other animals (externally)	?	
7.08	Propagules dispersed by other animals (internally)		
8.01	Prolific seed production	?	
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	y	1
8.03	Well controlled by herbicides	y	-1
8.04	Tolerates, or benefits from, mutilation or cultivation	y	1

8.05	Effective natural enemies present in U.S.		
Total Score			19

Outcome	Reject
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section	# questions answered	satisfy minimum?
A	10	Yes
B	9	Yes
C	18	Yes
total	37	Yes

Data collected 2008

Question number	Reference	Source data
1.01		Cultivated, but no evidence of selection for reduced weediness.
1.02		
1.03		
2.01	<p>1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lnd.tif). 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?20692 (02 June 2008). 4. Pacific Island Ecosystems at Risk (PIER) (2006) PIER Species Information. URL: http://www.hear.org/pier/species/jatropha_curcas.htm Accessed May 19, 2008. 5. Wagner, WL, et al. (1999) Manual of the Flowering Plants of</p>	<p>1. Global plant hardiness zones 7-13. 2. "In its centre of origin it is found in regions with average annual temperatures of 20°C to 28°C [68°F to 82°F], but it does withstand slight frost."; "<i>J. curcas</i> probably originated from Mexico and Central America, but it was introduced long ago in all tropical regions and some subtropical regions like Florida and South Africa. It is cultivated throughout the Malesian region, though especially in the drier areas." 3. "Distributional range: Native: NORTHERN AMERICA: Mexico: SOUTHERN AMERICA: Mesoamerica: Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua; Brazil: Brazil; Western South America: Bolivia; Peru; Southern South America:</p>

	<p>Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu.</p> <p>6. Whistler, WA (2000) Tropical Ornamentals: a Guide. Timber Press, Portland.</p> <p>7. Duke, JA. Handbook of Nuts. CRC Press, Boca Raton.</p> <p>8. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>Argentina; Paraguay; Other: widely cultivated & naturalized elsewhere in New World & Old World tropics." 4. "Native range: Native of the Caribbean region". 5. "Native presumably to Mexico and Guatemala." 6. "Native to tropical America from Mexico to Brazil and the West Indies". 7. "Annual temperature 18 to 28.5°C". 8. "Although the physic nut is of Mexican and Central American origin, it is cultivated in many other Latin American, Asian and African countries as a hedge and it was an important export product from the Cape Verde Islands during the first half of this century."; "The material collected originated mostly from Mexico and all Central American countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama, with the majority coming from Mexico. Many records also exist for the Caribbean: Bahamas, Cuba, Dominica, Dominican Republic, Haiti, Puerto Rico, Saint Lucia, Santo Domingo, St. Croix, Trinidad and other West Indian countries...Argentina, Bolivia, Brazil, Colombia, Ecuador and the Galapagos Islands, Paraguay, Peru and Venezuela. It has been introduced to Florida."; "The areas where it has been collected in the centre of origin and from where the material was taken for provenance trials show average annual temperatures well above 20°C and up to 28°C. Physic nut withstood slight frost in the Chã das Caldeiras, Fogo."</p>
2.02		
2.03	<p>1. Köppen-Geiger climate map (http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf).</p> <p>2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands.</p> <p>3. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland.</p>	<p>1. Most likely three climatic regions. 2. <i>J. curcas</i> probably originated from Mexico and Central America, but it was introduced long ago in all tropical regions and some subtropical regions like Florida and South Africa. It is cultivated throughout the Malesian region, though especially in the drier areas. 3. "Distributional range: Native: NORTHERN AMERICA: Mexico: SOUTHERN AMERICA: Mesoamerica:</p>

	<p>URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?20692 (02 June 2008).</p> <p>4. Pacific Island Ecosystems at Risk (PIER) (2006) PIER Species Information. URL: http://www.hear.org/pier/species/jatropha_curcas.htm Accessed May 19, 2008.</p> <p>5. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu.</p> <p>6. Whistler, WA (2000) Tropical Ornamentals: a Guide. Timber Press, Portland.</p> <p>7. Duke, JA. Handbook of Nuts. CRC Press, Boca Raton.</p> <p>8. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua; Brazil; Western South America: Bolivia; Peru; Southern South America: Argentina; Paraguay; Other: widely cultivated & naturalized elsewhere in New World & Old World tropics." 4. "Native range: Native of the Caribbean region". 5. "Native presumably to Mexico and Guatemala." 6. "Native to tropical America from Mexico to Brazil and the West Indies". 7. "Annual temperature 18 to 28.5°C". 8. "Although the physic nut is of Mexican and Central American origin, it is cultivated in many other Latin American, Asian and African countries as a hedge and it was an important export product from the Cape Verde Islands during the first half of this century."; "The material collected originated mostly from Mexico and all Central American countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama, with the majority coming from Mexico. Many records also exist for the Caribbean: Bahamas, Cuba, Dominica, Dominican Republic, Haiti, Puerto Rico, Saint Lucia, Santo Domingo, St. Croix, Trinidad and other West Indian countries...Argentina, Bolivia, Brazil, Colombia, Ecuador and the Galapagos Islands, Paraguay, Peru and Venezuela. It has been introduced to Florida."</p>
2.04	<p>1. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 2. Atlapedia Online (http://www.atlapedia.com/online/countries/belize.htm). 3. Atlapedia Online (http://www.atlapedia.com/online/countries/costa.htm). 4. Best Country Reports by World Trade Press (http://www.bestcountryreports.com/Precipitation_Map_El%20Salvador.html). 5. Atlapedia Online (http://www.atlapedia.com/online/countries/guat</p>	<p>1. For Mexico: average annual precipitation ranges from under 10 inches to over 80 inches. 2. For Belize: average annual precipitation varies from 1,270 mm (50 inches) in the north to more than 3,810 mm (100 inches) in the south. 3. For Costa Rica: average annual precipitation is 3,300 mm (130 inches) and rainfall patterns vary from region to region. 4. El Salvador: "Average annual precipitation is 49.2-98.4 inches/year". 5. For Guatemala: average annual precipitation varies from 1,140 mm (70 inches) to 5,080 mm (200</p>

	<p>emal.htm). 6. Atlapedia Online (http://www.atlapedia.com/online/countries/honduras.htm). 7. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 8. Atlapedia Online (http://www.atlapedia.com/online/countries/brazil.htm). 9. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 10. Atlapedia Online (http://www.atlapedia.com/online/countries/peru.htm). 11. Aquastat global information system on water and agriculture, Food and Agriculture Organization of the United Nations (http://www.fao.org/nr/water/aquastat/data/factsheets/aquastat_fact_sheet_arg.pdf). 12. Atlapedia Online (http://www.atlapedia.com/online/countries/paraguay.htm). 13. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 14. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 15. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>inches) depending on the region. 6. For Honduras: average annual precipitation varies from 1,770 mm (70 inches) to 2,540 mm (100 inches) in the north, while along the Pacific coastal plains it varies from 1,520 mm (60 inches) to 2,030 mm (80 inches). 7. For Nicaragua, average annual precipitation ranges from 60 inches/year to 80+ inches/year. 8. For Brazil: the nationwide average annual precipitation varies between 1,010 mm (40 inches) and 2,030 mm (80 inches). 9. For Bolivia, the average annual precipitation ranges from under 10 inches/year to 80 inches/year. 10. For Peru: average annual precipitation varies from 2,540 mm (100 inches) to 3,960 mm (156 inches) depending on the region. 11. For Argentina: long-term average annual precipitation is 591 mm/year (23.3 inches). 12. For Paraguay: average annual precipitation in the east is around 2,030 mm (80 inches) and diminishes westward to an average of 1,190 mm (47 inches). 13. "<i>J. curcas</i> is most successful in drier tropical regions with an average annual rainfall of 300-1000 mm [11.8 - 39.4 inches], but it has been reported from an area with 2380 mm [93.7 inches] of rain annually. 14. "<i>Jatropha</i> has been reported growing between 480 and 2380 mm [18.89 and 93.7 inches] annual rainfall, but for high yields the plant needs 625 to 750 mm [24.6 and 29.52 inches] precipitation." 15. "The current distribution of physic nut shows that introduction has been most successful in drier regions of the tropics with an average annual rainfall of between 300 and 1000mm [11.81 and 39.37 inches]."</p>
2.05	<p>1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. Whistler (2000) Tropical Ornamentals: a Guide. Timber Press,</p>	<p>1. "A native of the Caribbean region, physic nut has been introduced as a hedge and ornamental plant to many countries including Europe, Africa, India, Indonesia, the Philippines, and some Pacific islands and Australia." 2. "It is cultivated throughout the Malesian</p>

	<p>Portland. 4. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. University of Hawaii Press/Bishop Museum Press, Honolulu. 5. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?20692 (19 May 2008).</p>	<p>region, though especially in the drier areas." 3. "Is widely cultivated as an ornamental."; "It is planted mostly as a hedge, a support plant...or as a living fence post." 4. "Native presumably to Mexico and Guatemala, now widely distributed throughout tropical regions as a medicinal or hedge plant". 5. "Widely cultivated...in New World & Old World tropics."</p>
3.01	<p>1. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 2. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?20692 (19 May 2008). 3. Standley, PC, Steyermark, JA (1949) Flora of Guatemala. Fieldiana: Botany 24 (2): 126-128. Chicago Natural History Museum, Chicago.</p>	<p>1. "<i>J. curcas</i> frequently escapes from cultivation and may become naturalized." 2. "Distributional range:...Other: widely cultivated & naturalized elsewhere in New World & Old World tropics." 3. "Sometimes naturalized in the Old World tropics."</p>
3.02	<p>1. Meyer, J-Y. 2000. Preliminary review of the invasive plants in the Pacific islands (SPREP Member Countries). In: Sherley, G. (tech. ed.). Invasive species in the Pacific: A technical review and draft regional strategy. South Pacific Regional Environment Programme, Samoa. 190 pp. Accessed online at http://issg.appfa.auckland.ac.nz/database/species/..%5Cspecies%5Creference_files%5CSPREP.pdf#page=92. 2. Space, J.C. and Flynn, T. 2001. Report to the Kingdom of Tonga on invasive plant species of environmental concern. USDA Forest Service, Honolulu. 78 pp. Accessed online at http://www.hear.org/Pier/reports/treport.htm. 3. Northern Territory Government, Natural Resources, Environment and the Arts. Declared Weeds List. <i>Jatropha curcas</i>. Accessed online at http://www.nt.gov.au/nreta/natres/weeds/ntweeds/declared.html (November 13, 2008). 4. Department of Agriculture and Food, Government of Western Australia. Declared plant in Western Australia. <i>Jatropha curcas</i>.</p>	<p>1. Listed as a "potential invader" of lowland dense forest on Wallis and Futuna Islands. 2. Listed under the category of "Species that are mentioned or listed as being weedy or invasive elsewhere and are common or weedy in Tonga; "<i>Jatropha curcas</i> (fiki, physic nut) is widely used as a living fence throughout Tonga, from whence it escapes and naturalizes." 3. Listed as a Declared Weed, Schedule Class A/C. A = To be eradicated: reasonable effort must be made to eradicate the plant within the NT. C = Not to be introduced to the Territory: All Class A and Class B weeds are also considered to be Class C weeds. Applies to all of the Northern Territory unless otherwise stated. 4. Listed as a declared plant in Western Australia P1 for the whole state, P2 for certain municipal districts, and P4 for certain municipal districts. P1 = Prohibits movement; P2 = Aim is to eradicate infestation; P4 = Aims to prevent</p>

	<p>Accessed online at http://www.agric.wa.gov.au/content/PW/WEED/DECP/physic_nut.pdf (November 13, 2008). 5. Hannan-Jones, M and S Csurhes (2008) Pest Plant Risk Assessment: Physic Nut (<i>Jatropha curcas</i>). Biosecurity Queensland, Department of Primary Industries and Fisheries (http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Jatropha-Curcas-Risk-Assessment.pdf).</p>	<p>infestation spreading beyond existing boundaries of infestation. 5. "J. curcas is a declared weed in the Northern Territory and in Western Australia. It is an eradication target in the Northern Territory and was declared many years ago due to concern over its toxic seeds. It was declared in Western Australia as a precaution, since it is currently not found in that state." [so its declared weed status in NT is due to its toxicity, not its weediness, and it's not even in WA; but see 3.04 for explanation of 'yes' response]</p>
3.03	<p>Holm, L, et al. (1979) A Geographical Atlas of World Weeds. John Wiley and Sons.</p>	<p>Considered present as a weed of agriculture in Brazil, Fiji, Honduras, India, Jamaica, Panama, and El Salvador. [but not sufficient for a 'yes' response]</p>
3.04	<p>1. Hannan-Jones, M and S Csurhes (2008) Pest Plant Risk Assessment: Physic Nut (<i>Jatropha curcas</i>). Biosecurity Queensland, Department of Primary Industries and Fisheries (http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Jatropha-Curcas-Risk-Assessment.pdf). 2. Low, T and C Booth (2007) The Weedy Truth about Biofuels. Invasive Species Council, Melbourne (http://www.invasives.org.au/downloads/isc_biofuels_revised_march08.pdf).</p>	<p>1. "J. curcas has been listed as a weed in many countries. However, critical analysis of the published literature failed to find convincing evidence that it is having a significant impact on primary production or the environment...Based on the available evidence, it is reasonable to conclude that while J. curcas has clear propensity to escape cultivation and become naturalised, its potential impact appears relatively minor and localised." BUT 2. "It is especially problematic in the Comores Archipelago, east of Mozambique, where it is rated one of the four main invasive woody weeds of coastal vegetation, along with lantana, leucaena and guavas. In Australia, jatropha is a weed in Western Australia, the Northern Territory and north Queensland. The largest infestations occur in north Queensland—Emu Creek near Petford is infested along its entire length of 60 kilometres. Thickets of 20-30 plants occur along the creek, alternating with sections of stream where only scattered plants occur. The largest thicket is 100 m long and 50 m wide. <i>Jatropha</i> is also invasive on the nearby Hodgkinson River, where one</p>

		very dense infestation is 40-50 metres across." [since there is conflicting information on its status as an environmental weed, we are answering '?' for 3.04 and 'yes' for 3.02]
3.05	1. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 2. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	1. " <i>J. gossypifolia</i> is a serious weed in pastures in Papua New Guinea." 2. <i>Jatropha gossypifolia</i> is a relict weed in northern Australia.
4.01		No description of these traits.
4.02		
4.03		No Description of parasitism.
4.04	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. Standley, PC, Steyermark, JA (1949) Flora of Guatemala. Fieldiana: Botany 24 (2): 126-128. Chicago Natural History Museum, Chicago.	1. "The fresh seeds of physic nut are highly toxic...cattle have been poisoned in Europe." 2. "plants are not browsed" 3. "It is not eaten by stock of any kind."
4.05	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 4. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.	1. "The fresh seeds of physic nut are highly toxic...cattle have been poisoned in Europe." 2. The seeds "are often a source of poisoning, both in animals and humans". 3. "The oil of <i>Jatropha</i> is bitter and poisonous."; "The phorbol esters were found to have molluscicidal effects on the water snails that carry bilharzia and on snails like <i>Lymnaeaamicularia rubiginosa</i> ."; "The pure oil is toxic...For use as an insecticide, the oil is mixed with water in the ration 1:2." 4. "Many parts of the plants are used in traditional medicine. The seeds, however, are toxic to humans and many animals."
4.06	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden. 3. Duke, JA. Handbook of Nuts. CRC	1. "May act as an alternate host for plant pests, such as the cotton insect pest, <i>Calidea dregii</i> , in Tanzania". 2. "Although a number of diseases and pests have been observed in different regions in <i>J. curcas</i> , none of them

	<p>Press, Boca Raton. 4. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 5. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>causes serious problems." 3. "Mexicans grow the shrub as a host for the lac insect." 4. "In Brazil the pathogen <i>Spaceloma manihoticola</i>, a cassava disease, infests <i>Jatropha</i> too. Fungal diseases...are not significant." 5. "However, it should be pointed out that the physic nut is a host for cassava viruses that can be transmitted. Munch (1986) states that cassava superelongation disease (<i>Sphaceloma manihoticola/Elsinoe brasiliensis</i>) can be transmitted from the physic nut."</p>
4.07	<p>1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. Standley, PC, Steyermark, JA (1949) Flora of Guatemala. Fieldiana: Botany 24 (2): 126-128. Chicago Natural History Museum, Chicago. 4. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>1. "In man, particularly children, ingestion of the seed leads to typical gastroenteritis,...often proving fatal through exhaustion." 2. The seeds "are often a source of poisoning, both in animals and humans." 3. "This oil, or the whole seed, has drastic purgative properties, and if the seeds are eaten the results sometimes are dangerous or even fatal, at least in the case of small children."; "Since the seeds are dangerous when taken as food, their use for this purpose should be avoided." 4. "The seeds...are toxic to humans and many animals."; "Many cases of poisoning with physic nut are reported in the literature." BUT "The young leaves may be safely eaten when steamed or stewed. In the literature, it is reported that the physic nut seed is eaten in certain regions of Mexico once it has been boiled and roasted."</p>
4.08		
4.09	<p>Tropilab, Inc. (http://www.tropilab.com/jatropha-cur.html).</p>	<p>"Full sun".</p>
4.10	<p>1. USDA, National Resources Conservation Services (NRCS), Soil Survey Division, World Soil Resources (http://soils.usda.gov/use/worldsoils/mapindex/order.html). 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. El</p>	<p>1. Mexico: in the northern half of Mexico, the main soil order types are aridisols, entisols, and mollisols, with some alfisols and ultisols and a small amount of inceptisols (also with a small amount of andisols). In the southern half of Mexico, there are mostly inceptisols with some alfisols and ultisols, and a very small</p>

	<p>Bassam, N (1998) <i>Energy Plant Species: Their Use and Impact on Environment and Development</i>. James & James. 4. Heller, J (1996) <i>Physic nut: Jatropha curcas L. Promoting the conservation and use of underutilized and neglected crops</i>. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>amount of entisols and mollisols (and a very small amount of andisols); Belize: inceptisols, mollisols, and ultisols; Costa Rica: mostly ultisols with a small amount of inceptisols (also with a small amount andisols); El Salvador: mostly ultisols with small amounts of inceptisols and entisols (and andisols on the Pacific Coast); Guatemala: mostly alfisols, mollisols, and ultisols, with a small amount of inceptisols (and a small region of andisols on the Pacific Coast); Honduras: mostly alfisols, inceptisols, and ultisols, with very small amounts of entisols and mollisols; Nicaragua: mostly ultisols, with some alfisols and inceptisols (also with some andisols on the Pacific Coast); Brazil: a large amount of oxisols, with ultisols and entisols the next most prevalent types, alfisols, aridisols, mollisols, and inceptisols on the eastern side/east coast; Bolivia: ultisols, alfisols, inceptisols (mostly), mollisols (some), aridisols (some), entisols (some), (also a small amount of andisols); Peru: ultisols (mostly in central Peru), inceptisols (some), mollisols (some), entisols all along the Pacific Coast, (also oxisols in the north, a very small amount of andisols, and some rocky land along the border of the Pacific Coast entisols); Argentina: alfisols, aridisols, entisols, inceptisols, mollisols, small amounts of andisols and gelisols; Paraguay: mostly mollisols, alfisols, and ultisols, with some aridisols and a small amount of inceptisols and oxisols. 2. "It grows on well-drained, well-aerated soils and is well-adapted to low fertility." 3. "The soil requirements of <i>Jatropha</i> are modest; it can grow well on oligotrophic soil." 4. "It...is well adapted to marginal soils with low nutrient content...its strength as a crop comes from its ability to grow on poor, dry sites."</p>
4.11	<p>1. Parsons, WT, Cuthbertson, EG (2001) <i>Noxious Weeds of Australia</i>. CSIRO Publishing. 2. Padua, et al., eds. (1999) <i>Plant Resources of</i></p>	<p>1. "An erect shrub or small tree with one to several stems 2 to 4 m high" 2. "A somewhat succulent shrub or small tree</p>

	South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden. 3. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 4. Standley, PC, Steyermark, JA (1949) Flora of Guatemala. Fieldiana: Botany 24 (2): 126-128. Chicago Natural History Museum, Chicago. 5. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.	up to 5(-8) m tall." 3. "Glabrous shrubs or small trees 2-5 m tall." 4. "A shrub or small tree, sometimes 8 meters high but usually lower". 5. "Small tree or large shrub which can reach a height of up to 5 m."
4.12	1. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden, The Netherlands. 2. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.	1. "As plants are not browsed and grow into dense bushes they are favoured for living fences". 2. "It is spread by seeds on rocky slopes in Cape Verde, thus creating dense stands."
5.01		Terrestrial.
5.02	Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	<i>Euphorbiaceae</i>
5.03	Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	<i>Euphorbiaceae</i>
5.04	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.	1. "Root: Fleshy and tuberous". 2. "Normally, five roots are formed from seedlings, one central and four peripheral." [no description of bulbs, corms, or tubers with description of roots]
6.01		No evidence.
6.02	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Whistler, WA (2000) Tropical Ornamentals: A	1. "Reproducing by seed"; "The major spread is by seed". 2. "Propagate by...seeds." 3. "Grows readily from

	<p>Guide. Timber Press, Portland. 3. Duke, JA. Handbook of Nuts. CRC Press, Boca Raton. 4. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>seeds." 4. "It is spread by seeds."; "Germination needs 10 days."</p>
6.03	<p>Prabakaran AJ, Sujatha M (1999) <i>Jatropha tanjorensis</i> Ellis & Saroja, a natural interspecific hybrid occurring in Tamil Nadu, India. Genetic Resources and Crop Evolution 46 (3): 213-218.</p>	<p>"A detailed survey at its place of occurrence supplemented with data employed from cytological and peroxidase isozyme studies revealed that <i>J. tanjorensis</i> is a natural interspecific hybrid between [<i>J. curcas</i> and <i>J. gossypifolia</i>]."</p>
6.04	<p>1. Raju AJS, Ezradanam V (2002) Pollination ecology and fruiting behaviour in a monoecious species, <i>Jatropha curcas</i> L. (<i>Euphorbiaceae</i>). Current Science 83 (11): 1395-1398. 2. Qing, Y et al. (2007) Study on pollination biology of <i>Jatropha curcas</i> (<i>Euphorbiaceae</i>). Journal of South China Agricultural University 28 (3): 62-66. 3. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden. 4. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 5. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>1. "Both flower sexes open synchronously. The sexual system facilitates geitonogamy and xenogamy."; "The ability to self-pollinate through geitonogamy is considered to be adaptive for <i>J. curcas</i> for colonization." 2. "<i>J. curcas</i> was self-compatible and tended to cross-pollinate." 3. "Its occasionally bisexual flowers are self-compatible". 4. "Self-incompatibility does not seem to occur." 5. "The rare hermaphrodite flowers can be self-pollinating."</p>
6.05	<p>1. Raju AJS, Ezradanam V (2002) Pollination ecology and fruiting behaviour in a monoecious species, <i>Jatropha curcas</i> L. (<i>Euphorbiaceae</i>). Current Science 83 (11): 1395-1398. 2. Qing, Y et al. (2007) Study on pollination biology of <i>Jatropha curcas</i> (<i>Euphorbiaceae</i>). Journal of South China Agricultural University 28 (3): 62-66. 3. Dehgan, B, Webster, GL. Morphology and Infrageneric Relationships of the Genus <i>Jatropha</i> (<i>Euphorbiaceae</i>). University of California Press, Berkeley. 4. El Bassam, N (1998) Energy Plant Species: Their Use and</p>	<p>1. "The flower visitors include bees, ants, thrips and flies; bees and flies effect geitonogamy and xenogamy, while ants and thrips effect only geitonogamy."; "<i>Jatropha</i> is insect-pollinated." 2. Two species of honeybee and one species of butterfly were found to be the most effective pollinators of <i>J. curcas</i>. 3. "<i>Jatropha curcas</i> appears to be a moth-pollinated species because of its sweet, heavy perfume at night, greenish-white flowers, versatile anthers and protruding</p>

	Impact on Environment and Development. James & James. 5. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden. 6. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.	sexual organs, copious nectar, and absences of visible nectar guides." 4. "Pollination is by insects." 5. "Flowers of <i>Jatropha</i> are generally insect-pollinated."; "The sweet, heavy perfume at night and greenish-yellow flowers of <i>J. curcas</i> suggest that this species is pollinated by moths." 6. "Pollination of the physic nut is by insects."
6.06	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James.	1. "Reproducing by...suckers from the roots and crown"; "Established plants produce new shoots from the tuberous roots and crown each year." 2. " <i>J. curcas</i> can be easily propagated by stem cuttings 45-100 cm long and development is more rapid than from seed." 3. "There are generative and vegetative methods of propagation."
6.07	1. Parsons, WT, Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 4. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.	1. "The period between emergence and the appearance of first flowers is not with any certainty in Australia but is probably at least 2 years." 2. "In north-eastern Thailand, seedling plants 4-5 months after sowing are 1 m tall and start flowering."; " <i>J. curcas</i> cuttings start producing seed 4-5 months after planting." 3. "Once big enough to be planted out, <i>jatropha</i> can bear first fruits within a year." 4. "Fruit development needs 90 days from flowering until seeds mature."; 1-year-old plants yielded seeds in Thailand.
7.01	1. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu.	1. "Longer distance dispersal is...in mud adhering to...vehicles" BUT "a fleshy, globular capsule to 4 cm long", seeds 1.7 cm long. 2. "Seeds black, 1.5-2.2 cm long, beaked." [unintentional dispersal seems unlikely for such a big fruit/seed]
7.02	1. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 2. Whistler, WA	1. "It is cultivated throughout the Malesian region...In arid and semi-arid regions <i>J. curcas</i> is commonly planted as living fence and for erosion control."

	<p>(2000) Tropical Ornamentals: A Guide. Timber Press, Portland. 3. Duke, JA. Handbook of Nuts. CRC Press, Boca Raton. 4. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?20692 (19 May 2008). 5. Standley, PC, Steyermark, JA (1949) Flora of Guatemala. Fieldiana: Botany 24 (2): 126-128. Chicago Natural History Museum, Chicago. 6. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>2. "Is widely cultivated as an ornamental."; "It is planted mostly as a hedge, a support plant...or as a living fence post." 3. "Mexicans grow the shrub as a host for the lac insect."; "Widely planted". 4. "Widely cultivated...in New World & Old World tropics." 5. "Cultivated...in the Old World tropics." 6. "Considerable amounts of physic nut seeds were produced on Cape Verde during the first half of this century...Seeds were exported to Lisbon and Marseille for oil extraction and soap production."; "Today it is cultivated in many countries."</p>
7.03		No evidence.
7.04	<p>1. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 3. Dehgan, B, Webster, GL. Morphology and Infrageneric Relationships of the Genus <i>Jatropha</i> (<i>Euphorbiaceae</i>). University of California Press, Berkeley. 4. Standley, PC, Steyermark, JA (1949) Flora of Guatemala. Fieldiana: Botany 24 (2): 126-128. Chicago Natural History Museum, Chicago. 5. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>1. "A fleshy, globular capsule to 4 cm long". 2. "Capsules ellipsoid, 2.5-3 cm long and in diameter, essentially unlobed, ± fleshy, eventually drying and dehiscent." 3. "<i>Jatropha curcas</i> has a trilocular, ellipsoidal, subdrupaceous fruit, the exocarp of which remains fleshy until the seeds are mature, finally separating into three cocci. The fruit is 2.5-3.5 cm long and 2-2.5 cm wide." 4. "Ovary glabrous; capsule 2.5-4 cm. long, 2-3 celled, ellipsoid; seeds about 2 cm. long and 1 cm. broad, pale, oblong ellipsoid, with conspicuous black lines." 5. "After pollination, a trilocular ellipsoidal fruit is formed. The exocarp remain fleshy until the seeds are mature. The seeds are black, 2 cm long and 1 cm thick." [No evidence of adaptations to wind dispersal]</p>
7.05	Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	"Longer distance spread is in water flow".
7.06		
7.07	<p>1. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 2. Padua, et al., eds. (1999) Plant Resources of</p>	<p>1. "Longer distance dispersal is...in mud adhering to animal hooves" BUT "A fleshy, globular capsule to 4 cm long",</p>

	<p>South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 3. Hannan-Jones, M and S Csurhes (2008) Pest Plant Risk Assessment: Physic Nut (<i>Jatropha curcas</i>). Biosecurity Queensland, Department of Primary Industries and Fisheries (http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Jatropha-Curcas-Risk-Assessment.pdf).</p>	<p>seeds 1.7 cm long. [seems an unlikely mode of dispersal for such a large fruit/seed] 2. "Ants are presumably another dispersal vector as they may be attracted by the fleshy caruncle." [<i>Jatropha</i> spp.] 3. "it is not known to what extent seeds of <i>J. curcas</i> are dispersed by ants. The seeds of <i>J. curcas</i> are much larger than <i>J. gossypifolia</i> and do not have a prominent caruncle, which might make them less attractive to ants."</p>
7.08		
8.01	<p>1. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands. 2. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James. 3. Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>1. "Annual seed yield of <i>J. curcas</i> in Cape Verde is 400-1200 kg/ha; in Thailand average annual yields of 2150 kg/ha have been obtained. In the Philippines, 5-year-old plants produce 4-6 kg of dry seed." 2. "Under very favourable conditions <i>Jatropha</i> can yield 8t/ha of seed. Under less favourable conditions 0.2-2t/ha can be harvested." [Time period not reported] 3. "At least 2-3 t of seeds/ha can be achieved in semi-arid areas."; 25 months after planting, <i>Jatropha</i> shrubs in Senegal averaged ~7 seeds/shrub.</p>
8.02	<p>Heller, J (1996) Physic nut: <i>Jatropha curcas</i> L. Promoting the conservation and use of underutilized and neglected crops. 1. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.</p>	<p>Seeds in dry storage for 7 years germinated at a rate of 47% [though not in soil]; "High levels of viability and low levels of germination shortly after harvest indicate innate (=primary) dormancy."</p>
8.03	<p>Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.</p>	<p>"Slash close to the soil surface and immediately swab the cut surface with a picloram +2,4-D or picloram + triclopyr mixture in water...The picloram mixtures are also effective when used as basal bark applications. Useful control may also be obtained with hexazinone as a soil injection and with glyphosate, triclopyr and imazapyr applied as overall sprays."</p>
8.04	<p>1. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.</p>	<p>1. "Slashing by itself is of little use as it encourages regeneration from the roots".</p>

	<p>2. Padua, et al., eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands.</p>	<p>2. "They...can also be coppiced."</p>
<p>8.05</p>		