Australia/New Zealand Weed Risk Assessment adapted for Florida

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 U.S. using the Australian weed risk assessment. Biomass and Bioenergy. doi:10.1016/j.biombioe.2010.08.029.

Ricinus communis -- Florida 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 Florida's USDA climate 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 habitats with mean annual precipitation 40-70 inches.	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	y	4
3.04	Environmental weed	y	4
3.05	Congeneric weed	n	0
4.01	Produces spines, thorns or burrs	y	1
4.02	Allelopathic	?	
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	?	
4.05	Toxic to animals	y	1
4.06	Host for recognised pests and pathogens	y	1
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		
4.10	Grows on infertile soils (oligotrophic, limerock, or excessively draining soils).	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		
6.04	Self-compatible or apomictic	y	1
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative propagation	n	-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)	y	1
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 Florida, or east of the continental divide		
Total Score			24

Outcome	**Reject**

section	# questions answered	satisfy minimum?
A	11	Yes
B	8	Yes
C	18	Yes
total	37	Yes

Data collected 2008

Question number	Reference	Source data
1.01	van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden.	"Castor is indigenous to East Africa and probably originated in Ethiopia. It was already grown for its oil in Egypt some 6000 years ago and spread through the Mediterranean, the Middle East and India at an early date…" [cultivated for thousands of years, but selection has likely been for more fruits, potentially increasing weediness]
1.02		
1.03		
2.01	1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lgnd.tif). 2. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 3. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. Global plant hardiness zones 8-13. 2. "Castor is indigenous to East Africa and probably originated in Ethiopia…Castor is now grown in most drier areas of the tropics and subtropics and in many temperate areas with a hot summer…Castor grows throughout the warm-temperate and tropical regions. It has been commercially cultivated from 40°S to 52°N..., the limiting factor being frost...Castor requires average day temperatures of 20-26°C with a minimum of 15°C and a maximum of 38°C." 3. "Castor is indigenous to eastern Africa, and most probably originated in Ethiopia...Castor is a semi-tropical perennial now found throughout the warm-temperate and tropcial regions. It flourishes under such a variety of environments that its range cannot easily be defined."

2.02		
2.03	1. Köppen-Geiger climate map (http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf). 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 3. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 4. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 5. Wagner, Herbst, and Sohmer (1999) Manual of the flowering plants of Hawai'i. University of Hawai'i Press/Bishop Museum Press, Honolulu. 6. New Zealand Plant Conservation Network (2005) New Zealand adventive vascular plant list. Wellington.	1. Climate groups A - C are represented in the distribution range of the species. 2. The castor plant is naturalised throughout Africa south of the Sahara. 3. "Castor is indigenous to East Africa and probably originated in Ethiopia...Castor is now grown in most drier areas of the tropics and subtropics and in many temperate areas with a hot summer." 4. "It is now naturalised in all [Australian] States except Tasmania." 5. "in Hawai'i naturalized and sometimes common in low elevation, dry, disturbed habitats, 0-500 m, on all of the main islands" 6. Fully naturalized in New Zealand.
2.04	1. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 3. 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_ago.pdf). 4. Australian Government, Bureau of Meteorology (http://www.bom.gov.au/cgi-bin/climate/cgi_bin_scripts/annual-monthly-rainfall.cgi). 5. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 6. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 7. Atlapedia Online (http://www.atlapedia.com/online/countries/cameroon.htm). 8. Atlapedia Online (http://www.atlapedia.com/online/countries/centafri.htm). 9. Atlapedia Online (http://www.atlapedia.com/online/countries/congo.htm). 10. Atlapedia Online (http://www.atlapedia.com/online/countries/egypt.htm). 11. Atlapedia Online (http://www.atlapedia.com/online/countries/ethiopia.htm). 12. Atlapedia Online	1. "Castor produces highest yield with an annual rainfall of 600-700 mm [24-28 in] if this falls mainly in the early growing season, although 375-500 mm [15-20 in] will produce a reasonable yield with good water conservation." 2. "The plant thrives during periods of high rainfall but also withstands drought". 3. For Angola: long-term average annual precipitation is 1010 mm/year (39.76 inches). 4. For Australia: average annual precipitation ranges from 0 to 125.98 inches/year. 5. For Botswana: average annual precipitation ranges from under 10 inches/year to 40 inches/year. 6. For Burundi: average annual precipitation is between 20 inches/year and 60 inches/year. 7. For Cameroon: average annual precipitation is 4,030 mm (159 inches). 8. For the Central African Republic: in the north the average annual precipitation varies between 875 and 1,000 mm (34 and 39 inches) to between 1,500 and 2,000 mm (59 to 79 inches) in the south. 9. For the Congo: average annual precipitation varies from 1,250 to 1,750 mm (49 to 69 inches) while it is heaviest in the north and decreases towards the Atlantic Coast in the south. 10. For Egypt: precipitation is limited to the coastal area where it

	(http://www.atlapedia.com/online/countries/gabon.htm). 13. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 14. Atlapedia Online (http://www.atlapedia.com/online/countries/kenya.htm). 15. Atlapedia Online (http://www.atlapedia.com/online/countries/malawi.htm). 16. Atlapedia Online (http://www.atlapedia.com/online/countries/mozambiq.htm). 17. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 18. Atlapedia Online (http://www.atlapedia.com/online/countries/newzeal.htm). 19. Atlapedia Online (http://www.atlapedia.com/online/countries/nigeria.htm). 20. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 21. Atlapedia Online (http://www.atlapedia.com/online/countries/somalia.htm). 22. Atlapedia Online (http://www.atlapedia.com/online/countries/southafr.htm). 23. Atlapedia Online (http://www.atlapedia.com/online/countries/tanzania.htm). 24. Atlapedia Online (http://www.atlapedia.com/online/countries/uganda.htm). 25. Atlapedia Online (http://www.atlapedia.com/online/countries/DemRepCongo.htm). 26. Atlapedia Online (http://www.atlapedia.com/online/countries/zambia.htm). 27. Atlapedia Online (http://www.atlapedia.com/online/countries/zimbabwe.htm).	averages 200 mm (8 inches) per annum. 11. For Ethiopia: The hot semiarid northeastern and southeastern lowlands receive less than 500 mm (20 inches) of precipitation annually and are highly susceptible to drought. 12. For Gabon: during the wet season abundant rainfall occurs with the average annual precipitation in Libreville, 2,500 mm (98 inches) while between June to September there is virtually no rain. 13. For India: average annual precipitation for the entire country ranges from less than 10 to greater than 80 inches, however most of the country falls into the 20-60 inch range. 14. For Kenya: over 70% of the country is arid receiving less than 510 mm (20 inches) of annual precipitation while rainfall is greatest in the highlands. 15. For Malawi: average annual precipitation is 740 mm (29 inches). 16. For Mozambique: annual precipitation varies from 500 to 900 mm (20 to 35 inches) depending on the region with an average of 590 mm (23 inches). 17. For Namibia: average annual precipitation ranges from under 10 inches/year to 20 inches/year. 18. For New Zealand: average annual precipitation varies between 600 and 1,500 mm (24 and 59 inches). 19. For Nigeria: average annual precipitation varies from 1,770 mm (70 inches) in the west to 4,310 mm (170 inches) along the east coast, and to 470 mm (50 inches) in the central areas. 20. For Rwanda: average annual precipitation is between 20 inches/year and 60 inches/year. 21. For Somalia: most of the country has an average annual precipitation of less than 500 mm (20 inches) with severe droughts quite common. 22. For South Africa: average annual precipitation varies from 400 mm (16 inches) in the east to less than 50 mm (2 inches) in the northwest coastal regions. Average annual precipitation in Cape Town is 510 mm (20 inches). 23. For Tanzania:

		around 50% of the country receives an annual precipitation of 760 mm (30 inches) with the maximum being 2,540 mm (100 inches) at Lake Nyasa and the minimum, 510 mm (20 inches) on the Central Plateau. 24. For Uganda: the areas of Lake Victoria as well as the west and southwest mountains receive the highest amount of rainfall with an annual average precipitation exceeding 1,500 mm (60 inches) whereas the areas in the center or northeast receive less than 1,000 mm (39 inches) annually. 25. For the Democratic Republic of the Congo (Zaire): average annual precipitation of 1,700 mm (67 inches). 26. For Zambia: average annual precipitation varies between 1,000 mm and 1,400 mm (40 and 50 inches) in the north decreasing to 510 mm (21 inches) in the south. 27. For Zimbabwe: rainfall is highest on the High Veld with an average annual precipitation of up to 1,020 mm (40 inches) while the Middle Veld receives 410 mm to 610 mm (16 to 24 inches) and the Low Veld receives less than 400 mm (12 inches).
2.05	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	1. "Castor is indigenous to East Africa and probably originated in Ethiopia. It was already grown for its oil in Egypt some 6000 years ago and spread through the Mediterranean, the Middle East and India at an early date. In Chinese and European literature, it is not mentioned until the 9th and 15th centuries AD, respectively. Castor is now grown in most drier areas of the tropics and subtropics and in many temperate areas with a hot summer." 2. "Castor oil plant is a native of Africa and Euro-Asia which has been introduced to most countries of the world."
3.01	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. USDA, ARS, National Genetic Resources Program. Germplasm	1. "It naturalizes easily and grows in many areas as a ruderal plant." 2. "naturalized throughout tropics & subtropics, probable origin Africa" 3. "The castor plant is naturalised

	Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland (http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?31896). 3. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 4. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 5. Wagner, Herbst, and Sohmer (1999) Manual of the flowering plants of Hawai'i. University of Hawai'i Press/Bishop Museum Press, Honolulu. 6. New Zealand Plant Conservation Network (2005) New Zealand adventive vascular plant list. Wellington.	throughout Africa south of the Sahara". 4. "It is now naturalised in all [Australian] States except Tasmania." 5. "in Hawai'i naturalized and sometimes common in low elevation, dry, disturbed habitats, 0-500 m, on all of the main islands" 6. Fully naturalized in New Zealand.
3.02	1. Henderson, L (2001) Alien Weeds and Invasive Plants: a Complete Guide to Declared Weeds and Invaders in South Africa. Plant Protection Research Institute Handbook No. 12. 2. Waterhouse, DF (1997) The Major Invertebrate Pests and Weeds of Agriculture and Plantation Forestry in the Southern and Western Pacific. The Australian Centre for International Agricultural Research. No. 44. Canberra, Australia.	1. Declared invader (category 2) in South Africa; invades roadsides, wasteland. 2. Considered a weed of roadsides and waste places in the southern and western Pacific.
3.03	1. Holm, L, et al. (1979) A Geographical Atlas of World Weeds. John Wiley and Sons, New York. 2. Waterhouse, DF (1997) The Major Invertebrate Pests and Weeds of Agriculture and Plantation Forestry in the Southern and Western Pacific. The Australian Centre for International Agricultural Research. No. 44. Canberra, Australia.	1. R. communis considered a principal weed of agriculture in Tanzania, and a common weed of agriculture in Afghanistan, Australia, Brazil, Hawaii, Jamaica, Kenya, Rhodesia [Zimbabwe], and South Africa. 2. Considered a major weed of agriculture in the southern and western Pacific - affects vegetable crops.
3.04	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Richardson, DM, IAW Macdonald, JH Hoffman, and L Henderson (1997) Alien plant invasions. Pp. 535-570 in RM Cowling, DM Richardson, and SM Pierce (eds) Vegetation of Southern Africa, Cambridge University Press. 3. Tunison, JT, and NG Zimmer (1992) Success in controlling localized alien plants in Hawai'i Volcanoes National Park. Pp. 506-524 in CP Stone, CW Smith, and JT Tunison (eds) Alien Plant Invasions in Native Ecosystems of Hawai'i: Management and Research. University of Hawai'i Cooperative National Park Resources Studies Unit,	1. Considered an environmental weed in southern Africa, Australia, the western US, Mexico, the Galapagos, and Hawaii. Invades grassland, heathland, and riparian habitats. 2. Considered one of 84 important environmental weeds in southern African biomes; invades desert, forest, savanna, karoo, and fynbos. 3. Subject to control in Hawai'i Volcanoes National Park, though fairly localized. 4. declared invader (category 2) in South Africa; invades riverbanks, riverbeds.

	Honolulu. 4. Henderson, L (2001) Alien Weeds and Invasive Plants: a Complete Guide to Declared Weeds and Invaders in South Africa. Plant Protection Research Institute Handbook No. 12.	
3.05		monotypic genus
4.01	1. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	1. "Extremely spiny capsules are a deterrent to manual harvesting" 2. fruit an ovoid softly spiny capsule [but clearly from ref (1), spines can be hard enough in some varieties to be bothersome]
4.02	1. Jiang, HY, XW Gao, YN Zhang, XG Liu, and WZ He (2008) Allelopathic potential of Chinese medicinal plants on rice and paddy weeds. Allelopathy Journal 22: 337-343. 2. Qasem, JR (2002) Allelopathic effects of selected medicinal plants on Amaranthrus retroflexus and Chenopodium murale. Allelopathy Journal 10: 105-122.	1. R. communis was one of four medicinal plant species found to be inhibitory to germination and growth of rice paddy weeds. 2. Aqueous extracts of R. communis were found to be highly toxic to two weed species. [unclear whether these studies used natural concentrations]
4.03		no description of parasitism
4.04	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 3. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 4. Bossard, CC, JM Randall, and MC Hoshovsky (2000) Invasive Plants of California's Wildlands. University of California Press, Berkeley. 5. Motooka, P et al (2003) Weeds of Hawai'i's Pastures and Natural Areas: an Identification and Management Guide. College of Tropical Agriculture and Human Rseources, University of Hawai'i at Manoa (http://www.ctahr.hawaii.edu/invweed/WeedsHI/W_Ricinus_communis.pdf).	1. "Although they are somewhat toxic, mature leaves are occasionally used as a fodder, but care must be taken to avoid the more toxic young leaves." 2. "Young leaves are mildly toxic to animals and some insects, but in central Tanzania during the dry season when green fodder is almost non-existent, herds of eland (Taurotragus oryx) browsed giant castor with no apparent ill effects." 3. "Because of the nauseating odour when the leaves are crushed, the plant is unpalatable and rarely, if ever, eaten by stock." 4. "Leaves rarely show evidence of herbivory, although occasional leaf browse recently has been seen in the Santa Monica Mountains". 5. "Extremely poisonous to animals and humans. However, cattle and goats will strip the castor bean plant of all its leaves."
4.05	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys	1. "The seed, and to a minor extent other plant parts as well, contain extremely toxic proteins, the toxic alkaloid ricinine,

	Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	and allergens." 2. "Whole seeds are poisonous to animals and humans…The seed contains the toxic protein ricin and alkaloid ricinine."
4.06	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "Few diseases are of economic importance…Probably the most damaging pests are those attacking the inflorescence, such as mirids (Helopeltis spp.). Peach moth or castor shoot and capsule borer (Dichocrocis punctiferalis) is a most important pest in India and throughout South-East Asia." 2. "Castor is attacked by a multitude of insect pests, and even those which would probably never encounter the plant naturally, eat it with avidity!...Many of the major pests of castor also damage other common tropical crops, and when grown in the vicinity of large plantings of these crops, castor becomes liable to greatly increased levels of attack...A large range of pathogenic fungi has been recorded from castor...but few are of economic importance."
4.07	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "The seed, and to a minor extent other plant parts as well, contain extremely toxic proteins, the toxic alkaloid ricinine, and allergens." 2. "Whole seeds are poisonous to animals and humans;…human symptoms are vomiting, diarrhoea, dizziness, and a high temperature...The seed contains the toxic protein ricin and alkaloid ricinine."
4.08		
4.09		
4.10	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "Castor will grow on almost any soil type as long as it is well-drained and reasonably fertile. It prefers deep, sandy loams with pH 5-6.5." 2. "Castor will grow and produce a crop in almost any soil, with the exception of very heavy clay and poorly drained soils. It flourishes on the light sandy soils of North and South Africa, the Middle East and Australia, the more sandy loams of the USA and central Russia, lateritic

		soils in India, Central and East Africa and Brazil, and the alluvial clayey sands of many irrigated or seasonally flooded areas...Castor is often selected for areas marginal for other crops...".
4.11	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "soft-woody shrub or small tree, 1-5 m tall" 2. "Most wild types are large perennials often developing into small trees, cultivated types are usually short annuals."
4.12	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 3. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	1. "thicket forming plant" 2. "under suitable conditions dense thickets of castor occur" 3. "Dense patches of castor oil plant occur in waste places."
5.01		terrestrial
5.02	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland (http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?31896).	Euphorbiaceae
5.03	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland (http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?31896).	Euphorbiaceae
5.04	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "Taproot strong and with prominent lateral roots." 2. "Giant castor has a root system similar to typical woody perennials, with a large, well-developed tap-root which penetrates to several metres and has substantial laterals."
6.01		no evidence
6.02	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	1. "Castor is propagated by seed." 2. "reproducing by seed"; "seeds germinate readily"

6.03		
6.04	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "The frequency of natural out-crossing is commonly between 5-50%, but in some dwarf cultivars it may be as high as 90-100%." 2. "Castor is normally cross-pollinated, wind being the major agent in the tropics, but self-pollination of monoecious plants can occur."
6.05	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "pollination is by wind" 2. Wind is the major agent of pollination in the tropics.
6.06	Richardson, DM, IAW Macdonald, JH Hoffman, and L Henderson (1997) Alien plant invasions. Pp. 535-570 in RM Cowling, DM Richardson, and SM Pierce (eds) Vegetation of Southern Africa, Cambridge University Press.	Coppicing is listed as only means of vegetative propagation [which we are not counting as vegetative propagation].
6.07	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 3. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 4. Bossard, CC, JM Randall, and MC Hoshovsky (2000) Invasive Plants of California's Wildlands. University of California Press, Berkeley.	1. "Flowering starts early in the life of castor…The first flowers may open 40-70 days after sowing." 2. "Giant perennials in East Africa produce the first harvestable seed in approximately 140 days, imported dwarfs after 160 days." 3. "behaving as an annual plant where frosts are heavy and frequent" 4. "Plants become reproductive in the first season (within six months)".
7.01	Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing.	"Seed may also be spread during road grading, in garden refuse and in mud adhering to…vehicles." [speculative, and a fairly large fruit/seed]
7.02	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 3. Bossard, CC, JM Randall, and MC Hoshovsky (2000) Invasive Plants of California's Wildlands. University of California Press, Berkeley.	1. "Castor is indigenous to East Africa and probably originated in Ethiopia. It was already grown for its oil in Egypt some 6000 years ago and spread through the Mediterranean, the Middle East and India at an early date. In Chinese and European literature, it is not mentioned until the 9th and 15th centuries AD, respectively. Castor is now grown in most drier areas of the tropics and subtropics and in many

		temperate areas with a hot summer." 2. "Castor oil plant is a native of Africa and Euro-Asia which has been introduced to most countries of the world. It is cultivated extensively in France, Italy, Spain, the West Indies, and the southern United States...Probably the most important means of spread is man's commercial activities in growing the plant for its oil." 3. "This plant has been cultivated as an oil crop (Whitson 1992) and as an ornamental (Hogan 1992)."
7.03		no evidence
7.04	1. van der Vossen, HAM, and BE Umali, eds (2001) Plant Resources of South-East Asia. No. 14: Vegetable oils and fats. Backhuys Publishers, Leiden. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 3. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science.	1. "Fruit an ellipsoid to subglobose capsule, 15-25 mm long, brown, spiny or smooth. Seed ellipsoid, 9-17 mm long, compressed,…with a caruncle at the base". 2. fruit an "ovoid softly spiny capsule 1 to 3 cm diameter"; seed "smooth, 1.2 to 1.5 cm long, 6 to 10 mm wide" 3. "In some wild varieties the whole capsule falls from the desiccated raceme, the seeds remaining enclosed. This capsule may be blown by wind or washed by heavy rainfall a considerable distance from the parent plant, thus distributing the seeds over a wide area." [fruit/seed seem too large to be dispersed by wind - ref #3 is speculative]
7.05	1. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 2. Richardson, DM, IAW Macdonald, JH Hoffman, and L Henderson (1997) Alien plant invasions. Pp. 535-570 in RM Cowling, DM Richardson, and SM Pierce (eds) Vegetation of Southern Africa, Cambridge University Press.	1. "In some wild varieties the whole capsule falls from the desiccated raceme, the seeds remaining enclosed. This capsule may be blown by wind or washed by heavy rainfall a considerable distance from the parent plant, thus distributing the seeds over a wide area." 2. Water is one of main dispersal agents of R. communis.
7.06	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. PIER, Institute of Pacific Islands Forestry (http://www.hear.org/Pier/species/ricinus_communis.htm).	1. "Seeds are dispersed by birds and mammals" 2. "Although rodents and granivorous birds may disperse some seeds, man is the principal agent." [bird dispersal seems minor?]
7.07	1. Parsons, WT and Cuthbertson, EG (2001)	1. "Seed may also be spread…in mud

	Noxious Weeds of Australia. CSIRO Publishing. 2. Martins, VF, CRB Haddad, and J Semir (2009) Seed germination of Ricinus communis in predicted settings after autochorous and myrmecochorous dispersal. Journal of the Torrey Botanical Society 136: 84-90.	adhering to animals". [speculative, and fairly large fruit/seed] 2. "Seeds of Ricinus communis are primarily dispersed by autochory and secondarily dispersed by ants, which are attracted to their lipid-rich elaiosome."
7.08	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. PIER, Institute of Pacific Islands Forestry (http://www.hear.org/Pier/species/ricinus_communis.htm).	1. "Seeds are dispersed by birds and mammals" 2. "Although rodents and granivorous birds may disperse some seeds, man is the principal agent." [mammal dispersal seems minor?]
8.01	Bossard, CC, JM Randall, and MC Hoshovsky (2000) Invasive Plants of California's Wildlands. University of California Press, Berkeley.	"A single large plant 10.2 feet (8 m) diameter was found to produce 150,000 seeds, while a smaller plant thirty-nine inches (1 m) diameter produced only 1,500 seeds." [large tree: radius = 4 m; area = 50 m^2; 150,000 seeds/50 m^2 = 3,000 seeds/m^2; small tree: radius = 0.5 m; area = 0.8 m^2; 1,500 seeds/0.8 m^2 = 1875 seeds/m^2; both borderline seed densities, since this is a semi-woody shrub]
8.02	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Bossard, CC, JM Randall, and MC Hoshovsky (2000) Invasive Plants of California's Wildlands. University of California Press, Berkeley. 3. Richardson, DM, IAW Macdonald, JH Hoffman, and L Henderson (1997) Alien plant invasions. Pp. 535-570 in RM Cowling, DM Richardson, and SM Pierce (eds) Vegetation of Southern Africa, Cambridge University Press. 4. Bunn, K (2004) Weeds of the Hunter and Central Coast (http://www.lhccrems.nsw.gov.au/weeds_cd/riparian.html). 5. Weiss, EA (2000) Oilseed Crops (2nd edition). Blackwell Science. 6. Martins, VF, CRB Haddad, and J Semir (2009) Seed germination of Ricinus communis in predicted settings after autochorous and myrmecochorous dispersal. Journal of the Torrey Botanical Society 136: 84-90.	1. "Seeds…may remain dormant in the soil for several years." 2. "Areas of native vegetation subjected to fire have produced solid stands of castor bean, although castor bean plants had been absent from the area for more than ten years, suggesting that seeds of castor bean are long-lived". 3. seeds of R. communis categorized as "medium sized dry seeds: soil-stored" 4. "It can be difficult to control, as seeds can lay dormant for 30 years before germinating." BUT 5. "Seed of some cultivars may have a dormancy period of several months…However, the majority of modern dwarf hybrids are not dormant". 6. "Germination of old seeds was not enhanced in alternating temperatures and/or presence of light, as would be expected for seeds that make up persistent soil seed banks. This, and the fact that we found only a few viable seeds in the soil, indicates that Ricinus does not form seed banks. Nevertheless,

		we observed massive seedling emergence after soil disturbance and, therefore, the existence or not of seed banks is not yet clear and deserves further investigation."
8.03	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Parsons, WT and Cuthbertson, EG (2001) Noxious Weeds of Australia. CSIRO Publishing. 3. Tunison, JT, and NG Zimmer (1992) Success in controlling localized alien plants in Hawai'i Volcanoes National Park. Pp. 506-524 in CP Stone, CW Smith, and JT Tunison (eds) Alien Plant Invasions in Native Ecosystems of Hawai'i: Management and Research. University of Hawai'i Cooperative National Park Resources Studies Unit, Honolulu.	1. "an effective herbicide is glyphosate or picloram plus 2,4-D" 2. "Where cultivation is impractical, chemical control is effective. Although castor oil plant is tolerant of some herbicides, an overall spray of glyphosate or a picloram + 2,4-D mixture gives good results." 3. herbicide Banvel "nearly 100% effective" against R. communis
8.04	1. Richardson, DM, IAW Macdonald, JH Hoffman, and L Henderson (1997) Alien plant invasions. Pp. 535-570 in RM Cowling, DM Richardson, and SM Pierce (eds) Vegetation of Southern Africa, Cambridge University Press. 2. Bossard, CC, JM Randall, and MC Hoshovsky (2000) Invasive Plants of California's Wildlands. University of California Press, Berkeley.	1. coppices 2. "capable of resprouting from the root crown if cut"
8.05		