

**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.

<i>Leucaena leucocephala</i> -- 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	n	0
4.02	Allelopathic	?	
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	n	-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	n	0
4.08	Creates a fire hazard in natural ecosystems	n	0
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	y	1
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 propagation	?	
6.07	Minimum generative time (years)	1	1
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n	-1
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		
7.06	Propagules bird dispersed	?	
7.07	Propagules dispersed by other animals (externally)	n	-1
7.08	Propagules dispersed by other animals (internally)	y	1
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	?	
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		
<b>Total Score</b>			<b>21</b>

<b>Outcome</b>	<b>Reject</b>
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section	# questions answered	satisfy minimum?
A	11	Yes
B	9	Yes
C	18	Yes
total	38	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 (<a href="http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lnd.tif">http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lnd.tif</a>). 2. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959">http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959</a> Accessed June 2, 2008. 3. Global Invasive Species Database. Ecology of <i>Leucaena leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 4. Csurhes, S, Edwards, R (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 5. National Academy of Sciences (1979) Tropical Legumes: Resources for the Future. Washington. 6. Zárate, SP (1987) Taxonomic identity of <i>Leucaena leucocephala</i> (Lam.) de Wit with a new combination. <i>Phytologia</i> 63 (4): 304–306. 7. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 8. Hughes, CE (1998)</p>	<p>1. Global plant hardiness zones (10?-)11-12. 2. "Distributional range: Native: Northern America; Central Mexico: Mexico- Oaxaca, Veracruz. Southern America; Mesoamerica: Belize [n.], Guatemala [w.], Mexico-Campeche, Chiapa, Quintana Roo, Tabasco, Yucatan." 3. "Native range: Native to Mexico and Central America, although the precise native range is blurred". 4. "<i>L. leucocephala</i> is native to Central and South America". 5. "Native of Central America". 6. "A native to Mexico and Central America". 7. "<i>Leucaena</i> originated in the midlands of southern Mexico." 8. "<i>L. leucocephala</i> is essentially a tropical species requiring warm temperatures of 25-30°C for optimum growth and with poor cold tolerance and significantly reduced growth during cool winter months in subtropical areas." 9. "<i>Leucaena</i> originates in Mexico and Central America, though its origin is obscured by wide distribution by humans. Today, <i>Leucaena</i> is grown in many parts of the tropics."; "Growth is poor when the mean annual temperature is below 20°C." 10. "<i>Leucaena</i> evolved in the Guatemalan</p>

	<p><i>Leucaena</i>: A Genetic Resources Handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37: 182. 9. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James &amp; James. 10. Faridah, H, et al., eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 11. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008.</p>	<p>centre of genetic diversity"; "For optimal growth <i>Leucaena</i> requires warm conditions: mean annual temperature ranging from 20-26°C, maximum temperature range of the hottest month 24-32°C and minimum temperature range of the coldest month 16-24°C." 11. "Native throughout the West Indies from Bahamas and Cuba to Trinidad and Tobago, and from southern Mexico to northern South America."; "Annual mean temperature 14.7 to 27.4°C".</p>
2.02		
2.03	<p>1. Köppen-Geiger climate map (<a href="http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf">http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf</a>). 2. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959">http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959</a> Accessed June 2, 2008. 3. Global Invasive Species Database. Ecology of <i>Leucaena leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 4. Csurhes, S, Edwards, R (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 5. National Academy of Sciences (1979) Tropical Legumes: Resources for the Future. Washington. 6. Zárate, SP (1987) Taxonomic identity of <i>Leucaena leucocephala</i> (Lam.) de Wit with a new combination. Phytologia 63 (4): 304–306. 7. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 8. Hughes, CE (1998) <i>Leucaena</i>: A Genetic Resources Handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37: 182. 9. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James &amp; James. 10. Faridah, H,</p>	<p>1. Most likely three climatic regions. 2. "Distributional range: Native: Northern America; Central Mexico: Mexico-Oaxaca, Veracruz. Southern America; Mesoamerica: Belize [n.], Guatemala [w.], Mexico-Campeche, Chiapa, Quintana Roo, Tabasco, Yucatan." 3. "Native range: Native to Mexico and Central America, although the precise native range is blurred". 4. "<i>L. leucocephala</i> is native to Central and South America". 5. "Native of Central America". 6. "A native to Mexico and Central America". 7. "<i>Leucaena</i> originated in the midlands of southern Mexico." 8. "<i>L. leucocephala</i> is essentially a tropical species requiring warm temperatures of 25-30°C for optimum growth and with poor cold tolerance and significantly reduced growth during cool winter months in subtropical areas." 9. "<i>Leucaena</i> originates in Mexico and Central America, though its origin is obscured by wide distribution by humans." 10. "<i>Leucaena</i> evolved in the Guatemalan centre of origin." 11. "Native throughout the West Indies from Bahamas and Cuba to Trinidad and Tobago, and from southern Mexico to northern South America."</p>

	<p>van der Maesen, L.J.G., eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary Plants. Backhuys Publishers, Leiden, The Netherlands. 11. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008.</p>	
2.04	<p>1. Best Country Reports by World Trade Press (<a href="http://www.bestcountryreports.com/Precipitation_Map_EI%20Salvador.html">http://www.bestcountryreports.com/Precipitation_Map_EI%20Salvador.html</a>). 2. Atlapedia Online (<a href="http://www.atlapedia.com/online/countries/belize.htm">http://www.atlapedia.com/online/countries/belize.htm</a>). 3. Atlapedia Online (<a href="http://www.atlapedia.com/online/countries/guatemala.htm">http://www.atlapedia.com/online/countries/guatemala.htm</a>). 4. USDA, NRCS. 2008. The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 5. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 6. National Academy of Sciences. (1980) Firewood crops: Shrub and tree species for energy production. Washington, D.C. 7. El Bassam, N. (1998) Energy plant species : their use and impact on environment and development. James &amp; James. 8. Marnette, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia.</p>	<p>1. "Average annual precipitation is 49.2-98.4 inches/year". 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 Guatemala: average annual precipitation varies from 1,140 mm (70 inches) to 5,080 mm (200 inches) depending on the region. 4. "Precipitation, Minimum: 15. Precipitation, Maximum: 80." 5. "It tolerates a wide range of rainfall from 500-3500 mm [19.68-137.79 inches] and withstands strongly seasonal (6-8 month dry season) climates." 6. "The species grows best where annual rainfall is 600-1,700 mm [23.6-66.93 inches]. However, it is the dominant vegetation covering Honolulu's Diamond Head, where annual rainfall amounts to only 250 mm [9.84 inches]." 7. "An annual precipitation of 650-1500 mm [25.59-59.05 inches] is typical." 8. "<i>Leucaena</i> generally requires annual rainfall of 650-1500mm [25.59-59.05 inches], but can be found in drier and wetter sites depending on competitive vegetation."</p>
2.05	<p>1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 3. Csurhes, S, Edwards, R (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 4. National Academy of Sciences</p>	<p>1. Introduced to Cape Verde, Canary, Madeira, Micronesia, Melanesia, Polynesia. Invasive in natural areas and not native in southern Europe, Australia, southeastern USA, Mascarenes, Seychelles, Galapagos Islands, Hawaii, tropical South America, tropical Africa, southern Africa, temperate Asia, tropical Asia. 2. "Was introduced to the Philippines by the Spanish before 1815 and is now pantropically naturalised." [Many (over 50) countries are listed as</p>

	<p>(1980) Firewood Crops: Shrub and Tree Species for Energy production. Washington, D.C. 5. Nielsen. (1992) Flora Malesiana. Mimosaceae (Leguminosae- Mimosoideae). Series I. 11(1): 182-183. 6. El Bassam, N. (1998) Energy plant species: their Use and Impact on Environment and Development. James &amp; James. 7. Mannetje, L 't, Jones, RM, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia.</p>	<p>having distribution records for <i>Leucaena</i>]. 3. "It has been planted extensively throughout tropical areas of the world to provide cattle fodder, shade, firewood and to stabilise bare soil." 4. "Introduced to the Pacific islands, the Philippines, Indonesia, Papua New Guinea, Malaysia, and East and West Africa". 5. "Distribution- Tropical America, introduced and naturalized in most tropical areas of the worlds; in Malesia: all over the area."; "extensively cultivated especially in areas with a tropical seasonal climate." 6. "<i>Leucaena</i> originates in Mexico and Central America, though its origin is obscured by wide distribution by humans. Today, <i>Leucaena</i> is grown in many parts of the tropics." 7. "The 'common' shrubby form...is evidently indigenous to the Yucatan Peninsula. The arboreal 'Salvador' type...appears to have originated in the regions of Salvador, Guatemala and Honduras. Both forms were distributed widely throughout Mexico and Central America to northern South America prior to 1500 A.D. The common form was probably brought by Spanish galleons to the Philippines in the early 1600s, from whence it was pantropically distributed in the 19th Century...<i>Leucaenas</i> are found throughout South-East Asia".</p>
3.01	<p>1. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959">http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959</a> Accessed June 2, 2008. 2. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.a">http://www.issg.org/database/species/ecology.a</a> sp?si=23&amp;fr=1&amp;sts=sss. Accessed June 4, 2008. 3. Wagner, Herbst, and Sohmer (1999) Manual of the flowering plants of Hawai'i. University of Hawai'i Press/Bishop Museum Press, Honolulu. 4. Kairo, Ali, Cheesman, Haysom, and Murphy (2003) Invasive Species</p>	<p>1. "Distributional range: Native...Other: naturalized in s. Europe, tropical &amp; s. Africa, Asia, Australia, s.e. United States &amp; Hawaii, Macronesia, Mascarenes, Seychelles, Micronesia, Galapagos, Melanesia, &amp; Polynesia." 2. "Was introduced to the Philippines by the Spanish before 1815 and is now pantropically naturalised." 3. "Easily escaping and now widely naturalized throughout the tropics; in Hawai`i naturalized and very common". 4. Exotic and naturalized in Jamaica, Bahamas Islands, Haiti, Puerto Rico, Bermuda, Dominican Republic. 5. "It has</p>

	<p>Threats in the Caribbean Region. Report to the Nature Conservancy. 5. Csurhes, S, Edwards, R. (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 6. McVaugh, R. (1983) Flora Novo-Galiciana. The University of Michigan Press, Ann Arbor. 7. Nielsen. (1992) Flora Malesiana. Mimosaceae (Leguminosae- Mimosoideae). Series I. 11(1): 182-183. 8. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008.</p>	<p>naturalised throughout settlements in the Kimberley, across the Gulf of Carpentaria and throughout coastal Queensland and into northern New South Wales. It has also naturalised on a number of offshore islands including St Helena in Moreton Bay, Norfolk Island and Nhulunbuy." 6. "Naturalized in the tropics of the Old World." 7. "Distribution- Tropical America, introduced and naturalized in most tropical areas of the world; in Malesia: all over the area." 8. "Naturalized in...the Old World tropics."</p>
3.02	<p>1. Hughes, C E. (1998). Leucaena: a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182. 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. 3. Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council.</p>	<p>1. "It is a weed of open (often coastal) habitats, semi-natural, disturbed, degraded habitats, other ruderal sites (e.g. roadsides, abandoned fields and waste ground)". 2. Leucaena leucocephala is a major weed of roadsides and waste lands in the southern and western Pacific. 3. "Declared weed in W Cape &amp; declared invader elsewhere in South Africa." Invades forest margins, roadsides, wasteland, and riverbanks.</p>
3.03	<p>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.</p>	<p>1. <i>Leucaena leucocephala</i> is a Serious weed of agriculture in New Guinea, and a Principal weed of agriculture in Hawaii. 2. Leucaena leucocephala is a major weed of pasture and plantation forests in the southern and western Pacific.</p>
3.04	<p>1. Global Invasive Species Database. Ecology of <i>Leucaena leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 2. Weber (2003) Invasive Plant Species of the World. CABI Publishing.</p>	<p>1. "A serious or widespread weed invading semi-natural or natural habitats which are of some conservation interest."; "It renders extensive areas unusable and inaccessible and threatens native plants."; "<i>L. leucocephala</i> is spreading naturally and has been reported as a weed in more than 20 countries across all continents except Europe and Antarctica." 2. Considered an environmental weed in southern</p>

		Europe, tropical and southern Africa, temperate and tropical Asia, Australia, tropical South America, the Mascarenes, the Seychelles, the Galapagos, and Hawaii; invades coastal heath- and scrubland.
3.05		No evidence.
4.01	1. Van Den Beldt, RJ, Brewbaker, JL, eds. (1985) <i>Leucaena</i> Wood Production and Use. Nitrogen Fixing Tree Association, Waimanalo, Hawaii. 2. Global Invasive Species Database. Ecology of <i>Leucaena leucocephala</i> . URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a> . Accessed June 4, 2008.	1. "None of the leucaenas are thorny." 2. "This thornless tree".
4.02	1. USDA, NRCS (2008) The PLANTS Database ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Hughes, C E. (1998). <i>Leucaena</i> : a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182.	1. "Known Allelopath: Yes." [but quality of evidence unknown] BUT 2. "has no known allelopathic effects"
4.03		No description of parasitism.
4.04	1. USDA, NRCS (2008) The PLANTS Database ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Csurhes, S, Edwards, R (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 3. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 4. Hughes, CE (1998) <i>Leucaena</i> : A Genetic Resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37: 182. 5. Mannelje, L 't, Jones, RM, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 6. Van Den Beldt, RJ, Brewbaker, JL, eds. (1985) <i>Leucaena</i> Wood Production and Use. Nitrogen Fixing Tree Association, Waimanalo, Hawaii. 7. Duke, JA (1983)	1. "Fodder Product: Yes. Palatable Browse Animal: High. Palatable Graze animal: High." 2. "It has been planted extensively throughout tropical areas of the world to provide cattle fodder, shade, firewood and to stabilise bare soil." 3. "Suited mainly to cattle, water buffalo, and goats, <i>leucaena</i> forage is highly palatable, digestible, and nutritious. Both beef and dairy cattle thrive on it and can live on <i>leucaena</i> alone until mimosine-related toxicity occurs." 4. "It is one of the foremost tropical fodder trees"; "Most palatable fodder trees of the tropics". 5. "Foliage is fed to ruminant animals as browse or by cut-and-carry methods, or is milled for poultry and pelleted for export."; " <i>Leucaena</i> leaf meal is...shipped internationally...to Japan and Europe for animal feed."; " <i>Leucaena</i> is very palatable and stands can be easily



	<p>Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008. 8. Motooka, P et al. (2003) <i>Leucaena leucocephala</i>. In Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. University of Hawai'i, Mānoa.</p>	<p>weakened by heavy continuous grazing." 6. "Has been used widely for...forage"; "Is relished not only by livestock but also by many wild animals. In addition to cattle, sheep and goats, wild animals such as deer, elephants, wild pigs, kangaroos, rabbits and monkeys may also attack <i>leucaena</i> plants. Protection may be necessary during early stages of establishment." 7. "Leadtree is valued as an excellent protein source for cattle fodder, consumed browsed or harvested, mature or immature, green or dry." 8. "Goats will control koa haole [<i>leucaena</i>]".</p>
4.05	<p>1. Motooka, P, et al. (2003) <i>Leucaena leucocephala</i>. In Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. University of Hawaii, Mānoa. 2. USDA, NRCS (2008) The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 3. Wagner, et al. (1999) Manual of the Flowering Plants of Hawaii. University of Hawaii Press/Bishop Museum Press, Honolulu. 4. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 5. National Academy of Sciences (1979) Tropical legumes: resources for the future. Washington. 6. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 7. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James &amp; James. 8. Mannerje, L 't, Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 9. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008.</p>	<p>1. "Can be toxic to horses because of mimosine content, which cattle can tolerate somewhat." 2. "Toxicity: Moderate." 3. "About 5% of the protein of the leaflets consists of mimosine, an amino acid. When <i>Leucaena</i> makes up more than half of the diet of cattle for more than 6 months, general ill health and loss of hair may result. Other domestic animals are even less tolerant to mimosine." 4. "Whole plant toxic to livestock in quantity (more than 25% of diet)." 5. "Cattle feed on the leaves and stems of the bushy variety of <i>Leucaena</i> in Australia." [Note variety]; "However, <i>leucaena</i> forage has a drawback. Mimosine, an uncommon amino acid, comprises about 5 percent of the protein of the leaflets. If taken in excess, mimosine causes cattle to produce less than normal quantities of thyroxine, a thyroid hormone. Eventually, the cattle lose tail and rump hair and in extreme cases become completely debilitated with goiter. To avoid this, <i>leucaena</i> must always be fed in combination with grass or other feeds and kept to no more than one-third of the diet...Nonetheless, two decades of research have shown that <i>leucaena</i> complemented with grass can produce extraordinary weight gains in cattle, and can do so over extended periods with little or no adverse effect." 6. "Both beef and dairy cattle thrive on it</p>

		<p>and can live on <i>leucaena</i> alone until mimosine-related toxicity occurs. This can be delayed or eliminated entirely by supplementing the diet with other forages."; "Its foliage contains mimosine, toxic to ruminants if consumed in excessive amounts." 7. "Is highly digestible and relatively non-toxic."; "The foliage carries a mild toxin, the amino acid mimosine, which causes depilation in non-ruminant animals." 8. "<i>Leucaena</i> also contains the toxic amino-acid mimosine which has antimitotic and depilatory effects on animals. It occurs in high concentrations in the growing tips (8-12%), young leaves (4-6%) and young pods and seeds (4-5%). For this reason <i>leucaena</i> leaf cannot safely be included in rations for non-ruminants at a level above 5% on a DM basis."; although "In most countries in South and Central America, the United States, Mexico, Indonesia, the Philippines and India, rumen microbes can completely detoxify mimosine and DHP." 9. "If <i>Leucaena</i> makes up half the animals diet, problems result due to mimosine (3-5 percent, on a dry-weight basis, of the protein)."</p>
4.06	<p>1. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 2. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy Production. Washington, D.C. 3. Hughes, CE (1998) <i>Leucaena: A Genetic Resources Handbook</i>. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37: 182. 4. Mannerje, L 't, Jones, R M, eds. (1982) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 5. Van Den Beldt, RJ, Brewbaker, JL, eds. (1985) <i>Leucaena Wood Production and Use</i>. Nitrogen Fixing Tree Association, Waimanalo, Hawaii.</p>	<p>1. "The accidental spread of the psyllid insect defoliator <i>Heteropsylla cubana</i> in the mid 1980s can cause cyclical defoliation, but does not kill trees and the psyllid appears to have been brought under control by a number of generalist local (and in some cases introduced) psyllid predators and parasites." 2. "It is highly resistant to pests and diseases. Common pests are seed weevils, twig borers, and termites." 3. "Use of...<i>L. leucocephala</i>...is limited by...susceptibility to attack by termites and wood borers."; "Seeds of all species of <i>Leucaena</i> are predated at some level in the natural populations by seed feeding bruchid beetles."; "The most serious limitation of <i>L. leucocephala</i> is susceptibility to the psyllid defoliator <i>Heteropsylla cubana</i>." 4. "Diseases of</p>

		<p><i>leucaena</i> are few and include seedling rots such as <i>Phthophthora drechsleri</i> and <i>Fusarium semitectum</i> that attack primarily under waterlogged conditions. Until the mid-1980s <i>Leucaena</i> was relatively free of serious diseases and pests. However, devastating effects of the leucaena psyllid (<i>Heteropsylla cubana</i>), a small aphid-like sucking insect, have been experienced in many areas where <i>leucaena</i> is grown for fodder. Psyllid damage is rarely seen in <i>Leucaena's</i> centre of origin in South and Central America, and damage caused by the psyllid has decreased with time in other areas. Populations of these insects fluctuate through the season and can cause losses of over 50% in yield. Attempts to use predatory and parasitic insects for control have been variably successful."; "On plants allowed to grow tall, attacks of soft scale (<i>Coccus longulus</i>) and an associated sooty mould can be serious. Seed crops can also suffer yield reduction through attacks on the inflorescences and young pods from the larvae of the moth <i>Ithome lassula</i>. In some areas, notably Central America, burchid beetles can seriously reduce or destroy seed crops. Seedlings can suffer attack from cutworms and termites, but, provided there is an adequate stand density, subsequent production is usually not reduced." 5. "Seed quality [is] lowered by seed weevils, which may lead to disease infections as well."; "<i>Leucaena</i> has been widely spread around the world for more than a century with suprisingly few reported disease problems. Reported diseases include a bark gummosis, one defoliation leafspot, and some fungal diseases of seedlings in nurseries."; "Some <i>Leucaena</i> varieties are unusually susceptible, but most lines show less than 10% mortality."</p>
4.07	1. USDA, NRCS (2008) The PLANTS Database ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> , 6 June 2008). National	1. "Toxicity: Moderate." 2. "Indigenous cultivation as a minor food crop." 3.

	<p>Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Global Invasive Species Database. Ecology of <i>Leucaena leucocephala</i>. URL: <a href="http://www.issg.org/database/species/e">http://www.issg.org/database/species/e</a>. 3. Hughes, CE (1998) <i>Leucaena</i>: a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182. 4. Nielsen (1992) Flora Malesiana. Mimosaceae (Leguminosae- Mimosoideae). Series I. 11 (1): 182-183. 5. Manetteje, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 6. Faridah, H, van der Maesen, L J G, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary plants. Backhuys Publishers, Leiden. 7. Zárate, S P. (1987). Taxonomic identity of <i>Leucaena leucocephala</i> (Lam.) de Wit with a new combination. <i>Phytologia</i> 63(4): 304–306. 8. National Academy of Sciences. (1977) <i>Leucaena</i> : promising forage and tree crop for the tropics. Washington, D.C. 9. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008</p>	<p>"Domestication as a minor food plant in Mexico"; "The indigenous use of <i>Leucaena</i> as a minor food plant in Mexico and Central America, although documented in many ethnobotanical studies, has been less widely studied and appreciated."; "The unripe pods and seeds...are used as a minor food for human consumption." 4. "Young leaves, flowers and fruits are used in cooking. Seeds can be used as a substitute for coffee." 5. "In Asia people eat the young green shoots prior to leaflet unfolding, but in the Americas the green seeds are eaten." 6. "In Indonesia the mature seeds are eaten, either raw, cooked or mixed with other ingredients, sometimes after fermentation as a substitute for soybean, or added to coffee after roasting. Young pods are eaten raw or cooked and serve as a minor, but useful protein and vitamin supplement from the home garden." 7. "Both subspecies are cultivated for their edible seeds in Mexico." 8. "In Central America and Indonesia, <i>Leucaena</i> is used for food: young leaves and small pods are eaten raw, or cooked in soups, tacos, etc; mature seeds are roasted, and young dry seeds are 'popped' like popcorn."; "However, it is an unusual food and is not recommended for extensive use because, as noted earlier, mimosine causes loss of hair." Yet "This doesn't seem to happen in Central America or Indonesia". 9. "In the Philippine Islands, young pods are cooked as a vegetable and seeds are used as a substitute for coffee. Ripe seeds are sometimes eaten parched like popcorn." [and no other evidence of toxicity]</p>
4.08	<p>1. Van Den Beldt, RJ, Brewbaker, JL, eds. (1985) <i>Leucaena</i> Wood Production and Use. Nitrogen Fixing Tree Association, Waimanalo, Hawaii. 2. Smith, CW. Hawaiian Alien Plant Studies, University of Hawaii (<a href="http://www.botany.hawaii.edu/faculty/cw_smith/">http://www.botany.hawaii.edu/faculty/cw_smith/</a>)</p>	<p>1. "They can also be used as...firebreaks when planted at high population densities."; "<i>Leucaena</i> has rather thin bark and is very susceptible to fire when young...although <i>Leucaena</i> in full leaf is fairly slow to burn. Slow-moving, low intensity fires do less damage, burning</p>

	eu_leu.htm).	out a short distance into leucaena stands. There is little likelihood of fire burning very far into a plantation since most of the undergrowth is eliminated by the leucaena"; " <i>Leucaena</i> varieties...provide a quick-growing windbreak or firebreak."; "Firebreaks have been found to be effective with 15 to 20 <i>leucaena</i> rows spaced 1-2 m apart."; "Loss of leaves during drought or other conditions can make any firebreak more vulnerable, and trees may be burned." 2. "In mature monotypic stands fire is suppressed because of the low fuel load."
4.09	<p>1. Mannerje, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 2. Van Den Beldt, RJ, Brewbaker, JL, eds. (1985) <i>Leucaena</i> Wood Production and Use. Nitrogen Fixing Tree Association, Waimanalo, Hawaii. 3. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008. 4. Whitesell, CD and JA Parrotta (2008) <i>Leucaena leucocephala</i> (Lam.) de Wit. Woody Plant Seed Manual. USDA FS Agriculture Handbook 727 (<a href="http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf">http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf</a>). 5. Hughes, C E. (1998). <i>Leucaena</i>: a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182.</p>	<p>1. "<i>Leucaena</i> is often able to survive because of its ability to tolerate shade." BUT 2. "<i>Leucaena</i> is shade intolerant."; "is greatly reduced by shading. <i>Leucaena</i> is thus best grown in situations in which it has maximum exposure to sunlight"; "While the species does not tolerate shading well, suppressed or shaded trees are slow to die and often persist for years with very little growth until the canopy is opened." 3. "Doing best under full sun." 4. "Light shade is recommended during the first few weeks of seedling development, and full sun thereafter." 5. "not shade-tolerant"</p>
4.10	<p>1. USDA, NRCS. 2008. The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. National Academy of Sciences. (1980) Firewood crops: Shrub and tree species for energy production. Washington, D.C. 3. Hughes, CE (1998) <i>Leucaena</i>: a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37: 182. 4. El Bassam, N (1998) Energy plant species: their use and impact on environment and development. James &amp; James. 5. Faridah, H, van der Maesen, L J G, eds. (1997) Plant</p>	<p>1. "Adapted to Coarse Textured Soils: Yes. Adapted to Fine Textured Soils: Yes. Adapted to Medium Textured Soils: Yes." 2. "<i>Leucaena</i>'s root system allows it to tolerate a wide array of soil conditions. It is found in soils varying from rock to heavy clay to coral. Unaided, <i>Leucaena</i> grows well only in neutral or alkaline (especially limestone) soils. It grows poorly in acidic soils". 3. "Poor growth on acid soils"; "<i>L. leucocephala</i> is known to be intolerant of soils with low pH, low P, low Ca, high</p>

	<p>Resources of South-East Asia. No 11. Auxiliary plants. Backhuys Publishers, Leiden. 6. Van Den Beldt, RJ, Brewbaker, JL, eds. (1985) <i>Leucaena</i> Wood Production and Use. Nitrogen Fixing Tree Association, Waimanalo, Hawaii. 7. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008.</p>	<p>salinity, high aluminum saturation and waterlogging". 4. "The plant accepts a wide range of soils, but does best where the soil is a deep, fertile, moist and alkaline clay. <i>Leucaena</i> does not like poor drainage and waterlogging or acid soil that is low in calcium and/or high in aluminum and manganese." 5. "<i>Leucaena</i> favours deep, well-drained soils with pH &gt; 5, and has a low tolerance to soluble Al. It performs optimally on calcareous soils, but can be found on saline soils and on alkaline soils up to pH 8. <i>Leucaena</i> is not suited to acid soils with pH(H<sub>2</sub>O) &lt; 4.8 or to waterlogged conditions. Adequate levels of available phosphorous are needed." 6. "On coral-derived soils". 7. "The lea tree thrives on a wide range of soils, but the most rapid growth is on deep clay soils which are fertile, moist and alkaline. It tolerates aluminum and soils low in iron and phosphorus. It grows best on neutral or alkaline soils, but does poorly on acidic latosols unless MO, Ca, S and P are added. Its deep root system permits it to tolerate many soil types, from heavy soils to porous coral."</p>
4.11	<p>1. USDA, NRCS. 2008. The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Motooka, P et al. (2003) <i>Leucaena leucocephala</i>. In Weeds of Hawai'i's Pastures and Natural Areas: An Identification and Management Guide. University of Hawai'i, Mānoa. 3. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 4. Wagner, Herbst, and Sohmer (1999) Manual of the flowering plants of Hawai'i. University of Hawai'i Press/Bishop Museum Press, Honolulu. 5. Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 6. Hughes, C. (1998) Monograph of <i>Leucaena</i> (Leguminosae-Mimosoideae). Systematic botany monographs; monographic series of the American Society of Plant Taxonomists 55:107-110. 7. Mannerje, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA).</p>	<p>1. "Growth Habit: Tree, Shrub." 2. "Erect, woody shrub to 20 ft tall." 3. "Evergreen shrub, tree"; "A shrub or tree of 5-20 m height with a trunk up to 10 cm in diameter." 4. "Shrubs or small trees usually up to 9 m tall (maximum size recorded 20 m tall)." 5. "Unarmed shrub or small tree up to 4 m high". 6. "Small to medium-sized tree, 3-15 (-20) m tall, 5-50 cm bole diameter, variable shrubby and highly branched to arborescent with a short clear bole to 5 m". 7. "Shrub or tree up to 18 m tall".</p>

	No. 4. Forages. Prosea, Bogor, Indonesia.	
4.12	<p>1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Global Invasive Species Database. Ecology of <i>Leucaena leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 3. Csurhes, S, Edwards, R. (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 4. National Academy of Sciences. (1977) <i>Leucaena</i>: promising forage and tree crop for the tropics. Washington, D.C. 5. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a>. Accessed July 22, 2008. 6. Motooka, P et al. (2003) <i>Leucaena leucocephala</i>. In Weeds of Hawai'i's Pastures and Natural Areas: An Identification and Management Guide. University of Hawai'i, Mānoa.</p>	<p>1. "The shrub forms extensive and dense thickets displacing the original vegetation and reducing species richness." 2. "It can form dense monospecific thickets which are reported to be replacing native forest in some areas and threatening endemic species of conservation concern in some areas. Dense thickets, even if not of immediate conservation concern can render extensive areas of disturbed ground unusable and inaccessible." 3. "It has formed dense thickets along some creek lines in north Queensland". 4. "forms dense stands that choke out other plants" 5. "Forming dense stands"; "The crop soon produces a dense stand." 6. "Forms dense stands in dry to mesic pastures and forests."</p>
5.01	Kairo, Ali, Cheesman, Haysom, and Murphy (2003) Invasive Species Threats in the Caribbean Region. Report to the Nature Conservancy.	"Broad Habitat: Terrestrial."
5.02	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959">http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?21959</a> Accessed June 2, 2008.	<i>Fabaceae</i>
5.03	<p>1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. USDA, NRCS. 2008. The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 3. National Academy of Sciences. (1980) Firewood crops: Shrub and tree species for energy production. Washington, D.C. 4. El Bassam, N. (1998) Energy plant species : their use and impact on environment and</p>	<p>1. "It is a nitrogen-fixing species that increases soil fertility levels." 2. "Nitrogen Fixation: Medium." 3. "<i>Leucaena</i> is a nitrogen-fixing legume". 4. "<i>Leucaena</i> is one of the few woody tropical legumes"; "The plant can fix nitrogen at 500kg/ha/year." 5. "Throughout the tropics <i>Leucaenas</i> provide a major nitrogen-fixing component of lowland forests, notably on</p>

	development. James & James. 5. Mannelje, L 't & Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 6. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a> . Accessed July 22, 2008.	wasteland where they are often a primary source of fixed nitrogen in the ecosystem." 6. " <i>Leucaena</i> can fix more than 500 kg N/ha."; "Lateral roots near the soil surface carry Nitrogen-fixing Rhizobium nodules".
5.04	USDA, NRCS. 2008. The PLANTS Database ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	"Propagated by Bulb: No. Propagated by Corm: No. Propagated by Tubers: No."
6.01		No evidence.
6.02	1. USDA, NRCS. 2008. The PLANTS Database ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Csurhes, S, Edwards, R. (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 3. El Bassam, N. (1998) Energy plant species: their use and impact on environment and development. James & James. 4. Faridah, H, van der Maesen, L J G, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary plants. Backhuys Publishers, Leiden. 5. National Academy of Sciences. (1977) <i>Leucaena</i> : promising forage and tree crop for the tropics. Washington, D.C. 6. Duke, JA (1983) Handbook of Energy Crops. unpublished. URL: <a href="http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html">http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html</a> . Accessed July 22, 2008.	1. "Propagated by seed: Yes." 2. "The plant reproduces from seeds." 3. "Will produce viable seeds."; " <i>Leucaena</i> can be propagated by seed". 4. " <i>Leucaena</i> can be propagated by directly sowing seed." 5. "Seed viability is high and the seeds can be successfully planted by hand or by machine."; "Although they eventually grow rapidly, <i>Leucaena</i> seedlings are slow starters." 6. "Propagated by seed".
6.03	Hughes, C E. (1998). <i>Leucaena</i> : a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182.	"Triploid hybrids between <i>L. trichandra</i> and <i>L. leucocephala</i> apparently arose spontaneously in Indonesia"; " <i>L. leucocephala</i> x <i>L. esculenta</i> spontaneous triploid hybrids: seedlessness of these hybrids is widely recognized"; "spontaneous hybrids between <i>L. diversifolia</i> and <i>L. leucocephala</i> do occur in Mexico"



6.04	<p>1. Hughes, C E. (1998). <i>Leucaena</i>: a genetic resources handbook. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182. 2. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 3. El Bassam, N. (1998) Energy plant species : their use and impact on environment and development. James &amp; James. 4. Mannerje, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 5. National Academy of Sciences. (1977) <i>Leucaena</i>: promising forage and tree crop for the tropics. Washington, D.C.</p>	<p>1. "<i>Leucaena leucocephala</i> is known to be a self-compatible tetraploid." 2. "Self-fertile (promoting seed production even on isolated individuals)." 3. "Self-pollinating". 4. "The flowers are self-fertile and most seed results from self-pollination". 5. "Self-pollinated."</p>
6.05	<p>Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008.</p>	<p>"Pollinated by a wide range of generalist insects including large and small bees."</p>
6.06	<p>USDA, NRCS. 2008. The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.</p>	<p>Vegetative Spread Rate: Slow.</p>
6.07	<p>1. El Bassam, N. (1998) Energy plant species: their use and impact on environment and development. James &amp; James. 2. Whitesell, CD and JA Parrotta (2008) <i>Leucaena leucocephala</i> (Lam.) de Wit. Woody Plant Seed Manual. USDA FS Agriculture Handbook 727 (<a href="http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf">http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf</a>). 3. National Academy of Sciences. (1977) <i>Leucaena</i>: promising forage and tree crop for the tropics. Washington, D.C.</p>	<p>1. "Seedlings less than one year old will produce viable seeds." 2. "The common type varieties flower year-round, often beginning as early as 4 to 6 months after seed germination." 3. "seedlings less than a year old are often laden with pods"</p>
7.01	<p>Weber (2003) <i>Invasive Plant Species of the World</i>. CABI Publishing</p>	<p>"Fruits are thin and flat pods of 12-18 cm length and 1.2-2 cm width."; "seeds of 7-8 mm length and c. 4 mm width" [Not likely to be dispersed unintentionally].</p>
7.02	<p>1. Weber (2003) <i>Invasive Plant Species of the World</i>. CABI Publishing. 2. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL:</p>	<p>1. Introduced to Cape Verde, Canary, Madeira, Micronesia, Melanesia, Polynesia. Invasive in natural areas and not native in southern Europe, Australia,</p>

	<p><a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 3. Csurhes, S, Edwards, R (1998) National Weeds Program. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. The Director of the National Parks and Wildlife, Canberra, Australia. 4. National Academy of Sciences (1980) Firewood Crops: Shrub and Tree Species for Energy production. Washington, D.C. 5. Nielsen. (1992) Flora Malesiana. Mimosaceae (Leguminosae- Mimosoideae). Series I. 11(1): 182-183. 6. El Bassam, N. (1998) Energy plant species: their Use and Impact on Environment and Development. James &amp; James. 7. Mannetje, L 't, Jones, RM, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia.</p>	<p>southeastern USA, Mascarenes, Seychelles, Galapagos Islands, Hawaii, tropical South America, tropical Africa, southern Africa, temperate Asia, tropical Asia. 2. "Was introduced to the Philippines by the Spanish before 1815 and is now pantropically naturalised." [Many (over 50) countries are listed as having distribution records for <i>Leucaena</i>]. 3. "It has been planted extensively throughout tropical areas of the world to provide cattle fodder, shade, firewood and to stabilise bare soil." 4. "Introduced to the Pacific islands, the Philippines, Indonesia, Papua New Guinea, Malaysia, and East and West Africa". 5. "Distribution- Tropical America, introduced and naturalized in most tropical areas of the worlds; in Malesia: all over the area."; "extensively cultivated especially in areas with a tropical seasonal climate." 6. "<i>Leucaena</i> originates in Mexico and Central America, though its origin is obscured by wide distribution by humans. Today, <i>Leucaena</i> is grown in many parts of the tropics." 7. "The 'common' shrubby form...is evidently indigenous to the Yucatan Peninsula. The arboreal 'Salvador' type...appears to have originated in the regions of Salvador, Guatemala and Honduras. Both forms were distributed widely throughout Mexico and Central America to northern South America prior to 1500 A.D. The common form was probably brought by Spanish galleons to the Philippines in the early 1600s, from whence it was pantropically distributed in the 19th Century...<i>Leucaenas</i> are found throughout South-East Asia".</p>
7.03		No evidence.
7.04	<p>1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Wagner, Herbst, and Sohmer (1999) Manual of the flowering plants of Hawai'i. University of Hawai'i Press/Bishop Museum Press, Honolulu. 3.</p>	<p>1. "Fruits are thin and flat pods of 12-18 cm length and 1.2-2 cm width."; "seeds of 7-8 mm length and c. 4 mm width" 2. "Pods linear-oblong, 8-18(-20) cm long, (1.5-)2 cm wide, glabrous or puberulent,</p>

	<p>Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 4. McVaugh, R. (1983) Flora Novo-Galicianana. The University of Michigan Press, Ann Arbor. 5. Mannerje, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia. 6. Whitesell, CD and JA Parrotta (2008) <i>Leucaena leucocephala</i> (Lam.) de Wit. Woody Plant Seed Manual. USDA FS Agriculture Handbook 727 (<a href="http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf">http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf</a>).</p>	<p>on a stipe up to 3 cm long." 3. "Fruits: Brown pods, 110-180 mm long, straight, flattened but raised over the seeds, in distinctive clusters, splitting into two non-recurving halves." 4. "Fruit (15-) 17-21 cm long, ca. 1.8-2 cm wide". 5. "Pod 14-26 cm x 1.5-2 cm...Seeds 18-22 per pod, 6-10 mm long". [No evidence of adaptations to wind dispersal] 6. "The seeds are usually released from dehiscent legumes while still on the tree, although unopened or partially opened legumes may be carried some distance by wind." [seems unlikely to carry fruits/seeds very far]</p>
7.05		
7.06	<p>PIER, Institute of Pacific Islands Forestry (<a href="http://www.hear.org/Pier/species/leucaena_leucocephala.htm">http://www.hear.org/Pier/species/leucaena_leucocephala.htm</a>).</p>	<p>"The seeds are dispersed by rodents and granivorous birds and can also be spread in cattle manure." [bird dispersal seems minor]</p>
7.07	<p>1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Wagner, Herbst, and Sohmer (1999) Manual of the flowering plants of Hawai'i. University of Hawai'i Press/Bishop Museum Press, Honolulu. 3. Henderson, L. (2001) Alien Weeds and Invasive Plants. Agricultural Research Council. 4. McVaugh, R. (1983) Flora Novo-Galicianana. The University of Michigan Press, Ann Arbor. 5. Mannerje, L 't &amp; Jones, R M, eds. (1992) Plant Resources of South-East Asia (PROSEA). No. 4. Forages. Prosea, Bogor, Indonesia.</p>	<p>1. "Fruits are thin and flat pods of 12-18 cm length and 1.2-2 cm width."; "seeds of 7-8 mm length and c. 4 mm width" 2. "Pods linear-oblong, 8-18(-20) cm long, (1.5-)2 cm wide, glabrous or puberulent, on a stipe up to 3 cm long." 3. "Fruits: Brown pods, 110-180 mm long, straight, flattened but raised over the seeds, in distinctive clusters, splitting into two non-recurving halves." 4. "Fruit (15-) 17-21 cm long, ca. 1.8-2 cm wide". 5. "Pod 14-26 cm x 1.5-2 cm...Seeds 18-22 per pod, 6-10 mm long". [No evidence of adaptations to external dispersal]</p>
7.08	<p>1. Whitesell, CD and JA Parrotta (2008) <i>Leucaena leucocephala</i> (Lam.) de Wit. Woody Plant Seed Manual. USDA FS Agriculture Handbook 727 (<a href="http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf">http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf</a>). 2. PIER, Institute of Pacific Islands Forestry (<a href="http://www.hear.org/Pier/species/leucaena_leucocephala.htm">http://www.hear.org/Pier/species/leucaena_leucocephala.htm</a>).</p>	<p>1. "The legumes are commonly eaten by and pass through the digestive tracts of livestock, which appear to be important dispersal agents in pastures." 2. "The seeds are dispersed by rodents and granivorous birds and can also be spread in cattle manure."</p>
8.01	<p>1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Global Invasive Species Database. Ecology of <i>Leucaena</i></p>	<p>1. "Seed production is prolific." 2. "Flowering and seeding continually throughout the year as long as moisture</p>

	<p>Leucocephala. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 3. USDA, NRCS (2008) The PLANTS Database (<a href="http://plants.usda.gov">http://plants.usda.gov</a>, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 4. Hughes, C E. (1998). <i>Leucaena: a genetic resources handbook</i>. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182.</p>	<p>permits combined with self-fertility promotes abundant pod and seed set." 3. fruit/seed abundance: medium 4. "abundant seed production"</p>
8.02	<p>1. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 2. Mannetje, L 't &amp; Jones, R M, eds. (1992) <i>Plant Resources of South-East Asia (PROSEA)</i>. No. 4. Forages. Prosea, Bogor, Indonesia. 3. Whitesell, CD and JA Parrotta (2008) <i>Leucaena leucocephala (Lam.) de Wit</i>. Woody Plant Seed Manual. USDA FS Agriculture Handbook 727 (<a href="http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf">http://www.nsl.fs.fed.us/K&amp;L%20genera.pdf</a>).</p>	<p>1. "The soil seed bank can remain viable for at least 10-20 years after seed dispersal."; "Seed can remain viable for long periods (at least 20 years) in the soil." 2. "Seeds have a hard seed-coat and survive for a long time in the soil."; "Seeds must be scarified to improve germination". 3. seeds "with a thin but fairly durable seedcoat"</p>
8.03	<p>1. Motooka, P et al. (2003) <i>Leucaena leucocephala</i>. In <i>Weeds of Hawai'i's Pastures and Natural Areas: An Identification and Management Guide</i>. University of Hawai'i, Mānoa. 2. Weber (2003) <i>Invasive Plant Species of the World</i>. CABI Publishing.</p>	<p>1. "Sensitive to foliar-applied triclopyr. Susceptible to soil-applied tebuthiuron at 2 lb/acre and to cut-surface applications of picloram. Dicamba ineffective in cut-surface applications. Triclopyr ester applied basal bark and stump bark effective; 2,4-D in diesel and sometimes diesel alone effective in basal bark treatments." 2. "Larger stands can be slashed and the regrowth treated with herbicide."</p>
8.04	<p>1. Weber (2003) <i>Invasive Plant Species of the World</i>. CABI Publishing. 2. Global Invasive Species Database. Ecology of <i>Leucaena Leucocephala</i>. URL: <a href="http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss">http://www.issg.org/database/species/ecology.asp?si=23&amp;fr=1&amp;sts=sss</a>. Accessed June 4, 2008. 3. National Academy of Sciences. (1980) <i>Firewood crops: Shrub and tree species for energy production</i>. Washington, D.C. 4. Hughes, C E. (1998).. <i>Leucaena: a genetic resources handbook</i>. Tropical forestry papers, Commonwealth Forestry Institute. Oxford 37:182. 5. El Bassam, N. (1998) <i>Energy plant</i></p>	<p>1. "The plant coppices freely and resprouts from cuttings, stumps and root collars." 2. "It resprouts vigorously after cutting." 3. "The stumps readily coppice". 4. "<i>L. leucocephala</i> is very persistent over several decades of cutting or grazing, is highly productive, recovers quickly from defoliation". 5. "<i>Leucaena</i> coppices well and withstands almost any type or frequency of pruning or coppicing." 6. "Severe frost kills all above-ground parts, but below-ground parts survive and plants will regrow"</p>

	species : their use and impact on environment and development. James & James. 6. Faridah, H, van der Maesen, L J G, eds. (1997) Plant Resources of South-East Asia. No 11. Auxiliary plants. Backhuys Publishers, Leiden.	vigorously."
8.05		