

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

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

doi:10.1016/j.biombioe.2010.08.029.

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

4.08	Creates a fire hazard in natural ecosystems	?	
4.09	Is a shade tolerant plant at some stage of its life cycle	n	0
4.10	Grows on one or more of the following soil types: alfisols, entisols, or mollisols	y	1
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets		
5.01	Aquatic	n	0
5.02	Grass	y	1
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat	n	0
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally	y	1
6.04	Self-compatible or apomictic	y	1
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative fragmentation	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		
7.06	Propagules bird dispersed		
7.07	Propagules dispersed by other animals (externally)	n	-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)	n	-1
8.03	Well controlled by herbicides	y	-1

8.04	Tolerates, or benefits from, mutilation or cultivation	n	-1
8.05	Effective natural enemies present in U.S.		
Total Score			3

Outcome	Accept*
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*Used secondary screen from: Daehler, C. C., J.L. Denslow, S. Ansari, and H. Kuo. 2004. A risk assessment system for screening out harmful invasive pest plants from Hawaii's and other Pacific islands. *Conserv. Biol.* 18: 360-368.

section	# questions answered	satisfy minimum?
A	8	Yes
B	8	Yes
C	18	Yes
total	34	Yes

Data collected 2008

Question number	Reference	Source data
1.01		Cultivated, but no evidence of selection for reduced weediness. [Published data not available; sweet sorghum has been selected for less tillering, less seed shattering, less lodging, and less open pollination, all of which likely result in lower weediness (Z. Helsel, 2009). If this question received a 'yes' and -3 points, 1.02 would receive a ? (like 3.01) and 0 points, and 1.03 would receive a yes and 1 point. The total score would decrease to 1, still within the evaluate further category. Without data, we left this as undetermined.]
1.02		[Answer unclear because evidence for naturalization does not distinguish sweet sorghum from grain sorghum.]
1.03		[Answer is clearly "yes" because of shattercane and naturalization of grain sorghum (see 3.01).]

2.01	<p>1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lgnnd.tif). 2. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?35092 Accessed June 2, 2008. 3. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 4. Pacific Island Ecosystems at Risk (PIER) (2006) PIER Species Information. URL: http://www.hear.org/pier/species/sorghum_bicolor.htm Accessed June 6, 2008. 5. Wagner, WL, et al. (1999) Manual of the flowering plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 6. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 7. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 8. Howard, R (1974) Flora of the Lesser Antilles: Leeward and Windward Islands. Jamaica Plain, Mass. Arnold Arboretum, Harvard University. 9. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008. 10. <i>Sorghum bicolor</i> in Flora of Pakistan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=200026333. Accessed July 15, 2008. 11. De Wet, JMJ, Harlan, JR (1971) The origin and domestication of <i>Sorghum bicolor</i>. Economic Botany 25 (2): 128-135.</p>	<p>1. Global plant hardiness zones 8-13. 2. "Distributional range: Native to Africa; Northern Africa: Egypt; Northeast Tropical Africa: Chad, Ethiopia, Somalia, Sudan; East Tropical Africa: Kenya, Tanzania, Uganda; West-Central Tropical Africa: Cameroon, Central African Republic, Equatorial Guinea, Gabon, Zaire; West Tropical Africa: Benin, Burkina Faso, Cote D'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone; South Tropical Africa: Angola, Malawi, Mozambique, Zambia, Zimbabwe; Southern Africa: Botswana, Namibia, South Africa, Swaziland; Other: cultivated throughout tropic, subtropic, & warm-temperate regions; naturalized in South, Central, & North America, Australia, & India ". 3. "Temperature, Minimum (°F) 47". 4. "Native range: Northern Africa." 5. "Native to Northern Africa". 6. "The greatest variability in cultivated and wild sorghum is found in north-eastern Africa. It is thought that the crop was domesticated in Ethiopia by selection from wild <i>sorghum</i> types (<i>S. bicolor</i> (L.) Moench subsp. <i>verticilliflorum</i> (Steud.) Pipers, synonym: <i>S. arundinaceum</i> (Desv.) Stapf), between 5000 and 7000 years ago."; "Sterility can occur when night temperatures fall below 12-15°C during the flowering period. Sorghum is killed by frost." 7. "Sweet sorghum originated in the warm region of central Africa it is a cold sensitive plant"; "The minimum temperatures are 7-10°C for germination and 15°C for growth." 8. "General Distribution: Widely cultivated throughout the warmer parts of the world, probably of African origin. Distribution in Lesser Antilles: Guadeloupe, Martinique." 9. "Cultivated in China [native to Africa; widely cultivated in the tropics]." 10. "The cultivated Sorghum is grown as a crop in Sind, Punjab, Lower Baluchistan and the Punjab foothills." 11. "Its wide distribution...suggests an ancient origin."; "The wild representatives of <i>S. bicolor</i> are strictly African in distribution."</p>
2.02		

2.03	<p>1. Köppen-Geiger climate map (http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf). 2. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?35092 Accessed June 2, 2008. 3. Pacific Island Ecosystems at Risk (PIER) (2006) PIER Species Information. URL: http://www.hear.org/pier/species/sorghum_bicolor.htm Accessed June 6, 2008. 4. Wagner, W L et al. (1999) Manual of the flowering plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 5. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 6. El Bassam, N. (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 7. Howard, R. (1974) Flora of the lesser Antilles: Leeward and Windward Islands. Jamaica Plain, Mass. Arnold Arboretum, Harvard University. 8. Sorghum bicolor in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008. 9. Sorghum bicolor in Flora of Pakistan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=200026333. Accessed July 15, 2008.</p>	<p>1. Three climatic regions. 2. "Distributional range: Native to Africa; Northern Africa: Egypt; Northeast Tropical Africa: Chad, Ethiopia, Somalia, Sudan; East Tropical Africa: Kenya, Tanzania, Uganda; West-Central Tropical Africa: Cameroon, Central African Republic, Equatorial Guinea, Gabon, Zaire; West Tropical Africa: Benin, Burkina Faso, Cote D'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone; South Tropical Africa: Angola, Malawi, Mozambique, Zambia, Zimbabwe; Southern Africa: Botswana, Namibia, South Africa, Swaziland; Other: cultivated throughout tropic, subtropic, & warm-temperate regions; naturalized in South, Central, & North America, Australia, & India ". 3. "Native range: Northern Africa." 4. "Native to Northern Africa". 5. "The greatest variability in cultivated and wild sorghum is found in north-eastern Africa. It is thought that the crop was domesticated in Ethiopia by selection from wild sorghum types (<i>S. bicolor</i> (L.) Moench subsp. <i>verticilliflorum</i> (Steud.) Pipers, synonym: <i>S. arundinaceum</i> (Desv.) Stapf), between 5000 and 7000 years ago.". 6. "Sweet sorghum originated in the warm region of central Africa it is a cold sensitive plant". 7. "General Distribution: Widely cultivated throughout the warmer parts of the world, probably of African origin. Distribution in Lesser Antilles: Guadeloupe, Martinique." 8. "Cultivated in China [native to Africa; widely cultivated in the tropics]." 9. "The cultivated Sorghum is grown as a crop in Sind, Punjab, Lower Baluchistan and the Punjab foothills."</p>
2.04	<p>1. USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Grubben, G J H, Partohardjono, S, eds. (1996). Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden. 3. Rehm, S, Espig, G. (1991) The Cultivated Plants of the Tropics and Subtropics:</p>	<p>1. "Precipitation, Minimum 18. Precipitation, Maximum 60." 2. "Sorghum also tolerates waterlogging and can be grown in areas of high rainfall. It is, however, primarily a plant of hot, semi-arid tropical environments with rainfall from 400-600 mm that are too dry for maize." 3. "There are great differences in water requirements among cultivars. For the highest yields, 500-600 mm rain are</p>

<p>Cultivation, Economic Value, Utilization. Verlag Josef Margraf Scientific Books, Netherlands. // 1. Atlapedia Online (http://www.atlapedia.com/online/countries/egypt.htm). 2. Atlapedia Online (http://www.atlapedia.com/online/countries/chad.htm). 3. Atlapedia Online (http://www.atlapedia.com/online/countries/ethiopia.htm). 4. Atlapedia Online (http://www.atlapedia.com/online/countries/somalia.htm). 5. Atlapedia Online (http://www.atlapedia.com/online/countries/sudan.htm). 6. Atlapedia Online (http://www.atlapedia.com/online/countries/kenya.htm). 7. Atlapedia Online (http://www.atlapedia.com/online/countries/tanzania.htm). 8. Atlapedia Online (http://www.atlapedia.com/online/countries/uganda.htm). 9. Atlapedia Online (http://www.atlapedia.com/online/countries/cameroun.htm). 10. Atlapedia Online (http://www.atlapedia.com/online/countries/equaguin.htm). 11. Atlapedia Online (http://www.atlapedia.com/online/countries/gabon.htm). 12. Atlapedia Online (http://www.atlapedia.com/online/countries/DemRepCongo.htm). 13. Atlapedia Online (http://www.atlapedia.com/online/countries/burkina.htm). 14. Atlapedia Online (http://www.atlapedia.com/online/countries/burkina.htm). 15. 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_civ.pdf). 16. Atlapedia Online (http://www.atlapedia.com/online/countries/gabon.htm). 17. Britannica Online Encyclopedia (www.britannica.com/EBchecked/topic/232376/Ghana/55172/Climate). 18. Atlapedia Online (http://www.atlapedia.com/online/countries/gabon.htm). 19. Atlapedia Online (http://www.atlapedia.com/online/countries/liberia.htm). 20. Atlapedia Online (http://www.atlapedia.com/online/countries/</p>	<p>necessary." 3. "Early ripening cultivars have the least need for moisture, and can be grown with only 200-300 mm rain." 1. For Egypt: precipitation is limited to the coastal area where it averages 200 mm (8 inches) per annum. 2. For Chad: average annual precipitation in N'Djamena is 744 mm (29 inches). 3. For Ethiopia: the hot semiarid northeastern and southeastern lowlands receive less than 500 mm (20 inches) of precipitation annually. 4. For Somalia: most of the country has an average annual precipitation of less than 500 mm (20 inches) with severe droughts quite common. 5. For Sudan: average annual precipitation varies from 160 mm (6.3 inches) to around 1,000 mm (39 inches) in Khartoum with most rainfall occurring between April and October. 6. 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. 7. 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. 8. 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. 9. For Cameroon: average annual precipitation is 4,030 mm (159 inches). 10. For Equatorial Guinea: average annual precipitation varies from 1,930 mm (76 inches) at Malabo to 10,900 mm (36 feet) at Ureka on Bioko. 11. 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. 12. Democratic Republic of the Congo (Zaire) is crossed by the Equator and the seasons are reversed in the north and south. Both regions have two short wet seasons and two short dry seasons</p>
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<p>mali.htm). 21. Atlapedia Online (http://www.atlapedia.com/online/countries/mauritan.htm). 22. Atlapedia Online (http://www.atlapedia.com/online/countries/niger.htm). 23. Atlapedia Online (http://www.atlapedia.com/online/countries/nigeria.htm). 24. Atlapedia Online (http://www.atlapedia.com/online/countries/senegal.htm). 25. Atlapedia Online (http://www.atlapedia.com/online/countries/sierrale.htm). 26. 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). 27. Atlapedia Online (http://www.atlapedia.com/online/countries/malawi.htm). 28. Atlapedia Online (http://www.atlapedia.com/online/countries/mozambiq.htm). 29. Atlapedia Online (http://www.atlapedia.com/online/countries/zambia.htm). 30. Atlapedia Online (http://www.atlapedia.com/online/countries/zimbabwe.htm). 31. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 32. Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1). 33. Atlapedia Online (http://www.atlapedia.com/online/countries/southafr.htm). 34. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 35. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 36. Rehm, S, Espig, G (1991) The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilization. Verlag Josef Margraf Scientific Books, Netherlands. 37.</p>	<p>while the central area has an equatorial climate with an average annual precipitation of 1,700 mm (67 inches). 13. For Benin: average annual precipitation varies between 960 mm (38 inches) in the north and 1,340 mm (53 inches) in the south. 14. For Burkina Faso: average annual precipitation in Ouagadougou is 894 mm (35 inches). 15. For Cote D'Ivoire: long-term average annual precipitation is 1348 mm/year (53.07 inches/year). 16. For Gambia: average annual precipitation in Banjul is 1,295 mm (51 inches) and average temperature ranges are from 15 to 31 degrees Celsius (59 to 88 degrees Fahrenheit) in January to 23 to 32 degrees Celsius (73 to 90 degrees Fahrenheit) in June. 17. For Ghana: the mean annual precipitation is between 40 and 55 inches (1,020 and 1,400 mm), but there is a marked moisture deficit because of the long, intensely dry season that follows. In the southern forest country, where the annual mean precipitation from north to south has a range of about 50 to 86 inches (1,270 to 2,180 mm), there are two rainy seasons. 18. For Guinea: average annual precipitation at Conakry is 4,923 mm (193 inches). 19. For Liberia: average annual precipitation in Monrovia is 4,150 mm (163 inches). 20. Mali has three climatic zones. (1.) The Sudanic zone which receives 700 to 1,000 mm (28 to 39 inches) of annual precipitation. (2.) The Sahelian zone which receives 200 to 400 mm (8 to 16 inches) of precipitation and (3.) the Saharan zone which accounts for 40% of the land area and receives little or no rain. 21. Average annual precipitation varies from 300 to 600 mm (12 to 24 inches). (2.) The Sahelian zone which has decreasing rainfall northward and an average annual precipitation, in the south, of around 350 mm (14 inches). (3.) The coastal zone which is humid but with a temperate climate, receives less than 25 mm (1 inches) of annual precipitation. (4.) The Saharan zone receives 25 to 127 mm (1 to 5 inches) of annual precipitation with a rainy season from July to September. 22. For Niger: rainfall varies</p>
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	<p>De Wet, JMJ, Harlan, JR (1971) The origin and domestication of <i>Sorghum bicolor</i>. <i>Economic Botany</i> 25 (2): 128-135.</p>	<p>depending on the region and in the south the average annual precipitation is 500 mm (29 inches) while in the north it drops below 200 mm (8 inches) where conditions are sub desert or Sahelian. 23. 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. 24. For Senegal: rainfall decreases from the south with the wet season extending to October and an average precipitation varying from 1,500 mm (60 inches) to 1,000 mm (40 inches) in the north, to 510 mm (20 inches) in the east. 25. For Sierra Leone: average annual precipitation varies from 5,080 mm (200 inches) along the coast and decreases inland towards the north to 2,160 mm (86 inches). 26. For Angola: long-term average annual precipitation is 1010 mm/year (39.76 inches). 27. For Malawi: average annual precipitation is 740 mm (29 inches). 28. 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). 29. 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. 30. 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). 31. For Botswana: average annual precipitation ranges from under 10 inches/year to 40 inches/year. 32. For Namibia: average annual precipitation ranges from under 10 inches/year to 20 inches/year. 33. 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). 34. "Precipitation, Minimum 18. Precipitation, Maximum 60." 35. "Sorghum also tolerates waterlogging</p>
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		and can be grown in areas of high rainfall. It is, however, primarily a plant of hot, semi-arid tropical environments with rainfall from 400-600 mm [15.75 - 23.62 in] that are too dry for maize." 36. "There are great differences in water requirements among cultivars. For the highest yields, 500-600 mm [19.69 - 23.62 in] rain are necessary."; "Early ripening cultivars have the least need for moisture, and can be grown with only 200-300 mm [7.87 - 11.81 in] rain." 37. "It is most at home in areas with between 15 and 55 inches of rainfall."
2.05	<p>1. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York. 2. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 4. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008. 5. <i>Sorghum bicolor</i> in Flora of Pakistan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=200026333. Accessed July 15, 2008. 6. <i>Sorghum bicolor</i> Northern Sugar Cane from B & T World Seeds. URL: http://www.b-and-t-world-seeds.com/carth.asp?species=Sorghum%20bicolor&sref=5508. Accessed July 15, 2008.</p>	<p>1. "It was introduced to the Western Hemisphere in the early sixteenth century, and is now an important crop in the United States and Mexico." 2. "It was probably distributed from this centre of origin along shipping and trade routes through the Middle East to India at least 3000 years ago. From there, it is thought to have been carried to China along the silk route and through coastal shipping to Burma (Myanmar) and other parts of South-East Asia." 3. "Grain <i>sorghum</i>, grown for grain production, is the most important. It is extensively cultivated in several African countries, certain regions of India and in the USA." 4. "<i>Sorghum bicolor</i> is the important, tropical cereal sorghum. Originating in Africa, its cultivation for both grain and fodder spread throughout the tropics and subtropics of the Old World. It was introduced with the slave trade to America, including warm parts of the United States. It is now cultivated throughout most of China." 5. "The cultivated <i>Sorghum</i> is grown as a crop in Sind, Punjab, Lower Baluchistan and the Punjab foothills." 6. <i>Sorghum bicolor</i> seeds are for sale online.</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: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?35092 Accessed June 2, 2008. 2. New Zealand Plant</p>	<p>1. "Naturalized in South, Central, & North America, Australia, & India." 2. <i>Sorghum bicolor</i> is fully naturalized in New Zealand. 3. <i>Sorghum bicolor</i> has been recorded in 27 Mexican states as an alien flowering plant [which the authors consider naturalization]. 4. "An occasional escape from cultivation, most commonly along roads and ditches."</p>

	<p>Conservation Network (2005) New Zealand adventive vascular plant list. Wellington. 3. Villasenor, JL, Espinosa-Garcia, FJ (2004) The Alien Flowering Plants of Mexico. Diversity and Distributions 10: 113-123. 4. Howard, R (1974) Flora of the Lesser Antilles: Leeward and Windward Islands. Jamaica Plain, Mass. Arnold Arboretum, Harvard University.</p>	<p>[Unable to determine whether this might be grain rather than sweet sorghum. Sweet sorghum is likely to naturalize within 1-2 ft of parent plant (Z. Helsel, 2009), but infrequent.]</p>
3.02	<p>1. Lonsdale, WM (1994) Inviting trouble: introduced pasture species in northern Australia. Australian Journal of Ecology 19: 345-354.</p>	<p>1. "Appendix I. Exotic pasture species released into northern Australia between 1947 and 1985 that are listed as weeds, or as useful, or both. <i>Sorghum bicolor</i>...Weeds lists? N Y Y N; Useful? N". [Unable to determine whether this might be grain rather than sweet sorghum.]</p>
3.03		<p>no evidence.</p>
3.04		<p>no evidence.</p>
3.05	<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. 3. Henderson, L (2001) Alien Weeds and Invasive Plants. Agricultural Research Council.</p>	<p>1. <i>S. arundinaceum</i> is a principal weed in VEN. <i>S. halepense</i> is a Serious weed in many countries and a principal weed in many others as well. <i>S. verticilliflorum</i> is a Serious weed MAU and a 'Principal' weed MOZ, SAF, and UGA. <i>S. vulgare</i> is a 'Principal' weed in IND and VEN. 2. "Table 11: Major weeds of agriculture in the southern and western Pacific. <i>Sorghum arundinaceum</i>; <i>Sorghum halepense</i>; <i>Sorghum sudanense</i>." 3. <i>Sorghum halepense</i>'s "Invasive status: Agrestal, ruderal, special effect weed (competitive, poisonous)." Declared invader (category 2).</p>
4.01		<p>no description of these traits.</p>
4.02	<p>1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Inderjit, et al., eds. (1999) Principles and Practices in Plant Ecology: Allelochemical Interactions. CRC Press, Boca Raton.</p>	<p>1. "Known Allelopath: No." 2. "When sorghum residues are allowed to remain on the soil surface in no-tillage systems, or when they are tilled into the soil as green manures, they have shown strong weed suppressive potential. Overland (1966) described sorghum as a smother crop used to suppress weed populations over time."; "When sorghum residues or living plants are extracted or assayed directly, they contain a</p>

		variety of water-soluble substances that can inhibit germination or seedling growth."
4.03		no description of parasitism.
4.04	<p>1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008. 4. <i>Sorghum bicolor</i>. URL: http://www.plantzafrica.com/plantqrs/sorghum.htm. Accessed July 15, 2008. 5. Schaffert, RE (1992). Sweet Sorghum Substrate for Industrial Alcohol. Pp. 131-137 in Utilization of sorghum and millets (Gomes, MI, et al., eds.) Pantancheru, A.P., India: International Crops Research Institute for the Semi-Arid Tropics.</p>	<p>1. "Palatable Browse Animal: Medium. Palatable Graze Animal: High." 2. "An important feed grain and fodder crop in the Americas and Australia."; "<i>Sorghum</i> is also grown for forage, either for direct feeding to ruminants or for preservation as hay or silage." 3. "<i>Sorghum bicolor</i>...cultivation for...fodder". 4. "<i>Sorghum bicolor</i> is an important crop providing...fodder in the semi-arid tropics of the world."; "Sweet sorghums [<i>Sorghum bicolor</i> species] have also been widely used for the production of forage and silage for animal feed."</p>
4.05	<p>1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 4. Rehm, S, Espig, G (1991) The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilization. Verlag Josef Margraf Scientific Books, Netherlands. 5. <i>Sorghum bicolor</i>. URL: http://www.plantzafrica.com/plantqrs/sorghum.htm. Accessed July 15, 2008.</p>	<p>1. "Palatable Browse Animal: Medium. Palatable Graze Animal: High." 2. "An important feed grain and fodder crop in the Americas and Australia." <i>Sorghum</i> is also grown for forage, either for direct feeding to ruminants or for preservation as hay or silage." 3. "While in the USA it is used as animal feed." 4. "<i>Sorghum</i> is an important food for humans and animals in tropical Africa, in India and China." 5. "<i>Sorghum bicolor</i> is an important crop providing food and fodder in the semi-arid tropics of the world." [and no other evidence of toxicity]</p>
4.06	<p>1. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 2. Rehm, S,</p>	<p>1. "Diseases and pests: The most severe disease problem of <i>sorghum</i> in South-East Asia is grain moulds, caused by a complex of fungal pathogens (predominantly <i>Curvularia</i></p>

Espig, G (1991) *The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilization*. Verlag Josef Margraf Scientific Books, Netherlands.

lunata, *Fusarium* spp., and *Phoma sorghina*) that infect the grain during development and can lead to severe discoloration and loss of quality."; "Important foliar diseases in South-East Asia include anthracnose (*Colletotrichum graminicola*), leaf blight (*Exerohilum turcicum*), zonate leaf spot (*Gloeocercospora sorghi*), and tar spot (*Phyllacora sorghi*). Charcoal rot (*Macrophomina phaseolina*) is an important root and stem rot of *sorghum* in Thailand and the Philippines, particularly when terminal drought stress is severe. Chemical control of these diseases is rarely if ever practised. Other diseases of *sorghum* that are important in other areas of the world include downy mildew (*Peronosclerospora sorghi*), rust (*Puccinia purpurea*), and ergot (*Claviceps sorghi*). The main insect pests of sorghum are shoot fly (*Atherigona soccata*), stem borers (*Busseola fusca* and *Chilo partellus*), sorghum midge (*Calocoris angustatus*). The main control methods for these pests are cultural. Early sowing is particularly important as a mechanism to avoid large insect populations at times when plants are most susceptible to damage. High levels of host plant resistance are also available for sorghum midge, but only low levels of resistance for the other pests. As in the case of diseases, chemical control of insect pests is rarely practised. *Sorghum* is very susceptible to damage by storage pests, the main ones being rice weevil (*Sitophilus oryzae*), flour beetle (*Tribolium castaneum*) and the grain mothe (*Sitotroga cerealella*). Damage can be minimized by drying grain adequately before storage. Cultivars with hard grain also suffer less damage." 2. "*Sorghum* suffers from many parasites. Gungas diseases are especially found in humid areas of cultivation. The most important are the kernel smut (*Sphacelotheca sorghi*, controlled by seed disinfection) and downy mildew (*Sclerospora sorghi*, *S. graminicola*). The greatest damage is caused by insects. The *sorghum* midge *Contarinia sorghicola* appears in all

		cultivation areas...In the first 4-6 weeks the seedlings are very vulnerable to the shoot fly, <i>Atherigona varia</i> var. <i>soccata</i> ". [These data are not specific to sweet sorghum (hence the ?), but appear to be generalized pests/pathogens (Z. Helsel, 2009), resulting in a no response.]
4.07	1. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 2. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York. 3. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 4. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 5. Rehm, S, Espig, G (1991) The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilization. Verlag Josef Margraf Scientific Books, Netherlands. 6. <i>Sorghum bicolor</i> . URL: http://www.plantzafrica.com/plantqrs/sorghum.htm . Accessed July 15, 2008.	1. "Uses: Sorghum is an important staple food, particularly in semi-arid tropical regions of Africa and Asia." 2. " <i>Sorghum bicolor</i> is widely cultivated, being used as a grain, for syrup, and as a flavoring for beer." 3. "Toxicity: Moderate."; "Palatable Human: Yes." 4. "In Africa and India its grain is used for human consumption". 5. "Sorghum is an important food for humans and animals in tropical Africa, in India and China." 6. "Sorghum bicolor is an important crop providing food and fodder in the semi-arid tropics of the world." [and no evidence of toxicity]
4.08	USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	"Fire Resistant: No. Fire Tolerance: High."
4.09	USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	"Shade Tolerance: Intolerant."
4.10	1. USDA, National Resources Conservation Services (NRCS), Soil Survey Division, World Soil Resources (http://soils.usda.gov/use/worldsoils/mapindex/order.html). 2. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 3.	1. Egypt: mostly aridisols and entisols (also with some shifting sands); Chad: mostly entisols with some alfisols, inceptisols, and ultisols (and also some shifting sands and a small amount of rocky land); Ethiopia: mostly entisols, inceptisols and ultisols with small amounts of alfisols and aridisols (and small amounts of andisols, oxisols, and shifting

	<p>Grubben, GJH, Partohardjono, S, eds. (1996) <i>Plant Resources of South-East Asia</i>. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 4. El Bassam, N (1998) <i>Energy Plant Species: Their Use and Impact on Environment and Development</i>. James & James (Science Publishers) Ltd, London. 5. <i>Sorghum bicolor</i>. URL: http://www.plantzafrica.com/plantqrs/sorghum.htm. Accessed July 15, 2008.</p>	<p>sands); Somalia: mostly aridisols with some entisols and a small amount of ultisols (and also with a small amount of shifting sands); Sudan: mostly aridisols and entisols in the north, with some ultisols. The south has entisols and ultisols with some alfisols and inceptisols (and also some oxisols and shifting sands); Kenya: mostly entisols and aridisols with some ultisols and inceptisols, and a small amount of alfisols (also with a small amount of oxisols and andisols); Tanzania: mostly ultisols with some alfisols and inceptisols and a small amount of entisols (also with a small amount of oxisols and andisols); Uganda: almost entirely oxisols and inceptisols with very small amounts of alfisols and ultisols; Cameroon: primarily oxisols with some ultisols and alfisols and small amounts of inceptisols and entisols (and also a small amount of andisols); Equatorial Guinea: primarily oxisols with a small amount of entisols on the east coast; Gabon: entisols, inceptisols, and oxisols, with a small amount of ultisols; Zaire (now called Democratic Republic of Congo): almost entirely oxisols and ultisols, with some entisols and inceptisols; Benin: mostly alfisols with small amounts of inceptisols and ultisols; Burkina Faso: mostly alfisols and entisols with small amounts of inceptisols and ultisols (and a small amount of shifting sands); Côte d'Ivoire: primarily ultisols with a small amount of alfisols and very small amounts of inceptisols and gelisols (and also a very small amount of oxisols); Gambia: alfisols, entisols, and ultisols; Ghana: primarily alfisols with some ultisols and small amounts of gelisols and inceptisols (and also a small amount of oxisols); Guinea: mostly inceptisols and ultisols (with a small amount of oxisols in the southern region); Liberia: primarily oxisols with some ultisols; Mali: the northern part is comprised of aridisols, entisols, and shifting sands and the south is mostly alfisols with some entisols and inceptisols and a small amount of ultisols; Mauritania: mostly entisols with a small amount of aridisols (and also some shifting</p>
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		<p>sands and a small amount of rocky land); Niger: mostly entisols with a small amount of alfisols and a very small amount of inceptisols and ultisols (and also some shifting sands); Nigeria: mostly alfisols with some inceptisols, entisols, and ultisols (and a very small amount of oxisols); Senegal: mostly alfisols with some entisols and inceptisols and a very small amount of ultisols (and also a small amount of shifting sands); Sierra Leone: mostly oxisols with some inceptisols and a very small amount of ultisols and entisols along the coast; Angola: primarily entisols with some alfisols, inceptisols, and ultisols and a small amount of aridisols (also with some oxisols); Malawi: mostly oxisols and alfisols with a small amount of inceptisols and ultisols; Mozambique: mostly alfisols with some entisols and oxisols, a small amount of inceptisols and aridisols, and a very small amount of ultisols (also a small amount of the "shifting sands" soil order type); Zambia: mostly oxisols with some alfisols, entisols, inceptisols, and ultisols (also a small amount of the shifting sands soil order type); Zimbabwe: almost entirely alfisols with some aridisols, entisols, and inceptisols, and a very small amount of ultisols (also with a very small amount of oxisols); Botswana: mostly "shifting sands" with some entisols, a small amount of alfisols, and a very small amount of inceptisols; Namibia: mostly aridisols and entisols with some alfisols, inceptisols, and ultisols (also with some of the shifting sands soil order type); South Africa: Swaziland: mostly alfisols with some oxisols and a very small amount of aridisols, ultisols, and inceptisols. 2. "Adapted to Coarse Textured Soils: Yes. Adapted to Fine Textured Soils: Yes. Adapted to Medium Textured Soils: Yes." 3. "<i>Sorghum</i> can be grown successfully on a wide range of soil types. It is well suited to heavy Vertisols found commonly in the tropics, where its tolerance of waterlogging is often required, but is equally suited to light sandy soils." 4. "<i>Sorghum</i> can be grown successfully on a</p>
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		<p>wide range of soils, such as heavy clays, medium loams, calcareous soils and organic soils. It tolerates a pH range from 5.5 to 8.5, and also some degree of salinity, alkalinity and poor drainage." 5. "<i>Sorghum</i> grows in a wide variety of soils and is drought resistant, but it will do better if the soil is enriched with compost or fertilisers prior to planting".</p>
<p>4.11</p>	<p>1. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York. 2. Clayton, WD, et al. (2006 onwards). GrassBase - The Online World Grass Flora. http://www.kew.org/data/grasses-db/www/imp09507.html. Accessed 06 June 2008. 3. Wagner, WL, et al. (1999) Manual of the flowering plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 4. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 5. De Wet, JMJ (1978) Systematics and evolution of <i>Sorghum</i> sect. <i>Sorghum</i> (<i>Gramineae</i>). American Journal of Botany 65 (4): 477-485. 6. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 7. Howard, R (1974) Flora of the Lesser Antilles: Leeward and Windward Islands. Jamaica Plain, Mass. Arnold Arboretum, Harvard University. 8. <i>Sorghum bicolor</i> in <i>Gramineae</i> (<i>Poaceae</i>) in Flora of Taiwan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=1050&taxon_id=200026333. Accessed July 15, 2008. 9. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008. 10. Clayton, WD et al. (2008). GrassBase - The Online World Grass Flora. URL: http://www.kew.org/data/grasses-db.html. Accessed July 15, 2008. 11. <i>Sorghum bicolor</i>. URL:</p>	<p>1. "Culms 50-500+ cm tall, 1-5 cm thick, sometimes branching above the base". 2. "Culms erect; robust; 100-600 cm long; 50-300 mm diam." 3. "Culms 10-30 dm tall". 4. "Vigorous annual grass, 0.5-5.0 m tall, with one to many tillers, originating from the base or later from stem nodes. Seedling radicle replaced by fibrous adventitious roots emerging from lowest nodes below and immediately above ground level...Stem solid, usually erect." 5. "Culms erect, slender to robust, 0.5 m to over 5 m tall." 6. "Growth Form: Bunch. Growth Habit: Graminoid." 7. "Large, succulent annual with culms mostly 1-2 m. tall and long, thin blades 1-5 cm. broad." 8. "Annuals; culms solid, erect, tall, about 2 cm in diameter." 9. "Annual. Culms erect, robust, 3-5 m tall, 2-5 cm in diam." 10. "Habit: Annual. Culms erect; robust; 100-600 cm long; 50-300 mm diam." 11. "This is a cane like grass, up to 6 m tall with large branched clusters of grains." 12. "Culms erect, slender to robust, 0.5 m to over 5 m tall, branched or unbranched at maturity."</p>

	<p>http://www.plantzafrica.com/plantqrs/sorghum.htm. Accessed July 15, 2008. 12. Doggett, H (1988) <i>Sorghum</i>. Longman Scientific & Technical (Essex, England) with John Wiley & Sons, Inc. (New York) and The International Development Research Centre (Canada).</p>	
4.12		
5.01		Terrestrial
5.02	<p>1. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?35092 Accessed June 2, 2008. 2. El Bassam, N (1998) <i>Energy Plant Species: Their Use and Impact on Environment and Development</i>. James & James (Science Publishers) Ltd, London. 3. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.</p>	<p>1. "<i>Poaceae</i>". 2. "Sweet sorghum is a C4 crop that belongs to the grass family." 3. "Growth Habit: Graminoid."</p>
5.03	<p>USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?35092 Accessed June 2, 2008.</p>	<i>Poaceae</i>
5.04	<p>1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Grubben, GJH, Partohardjono, S, eds. (1996) <i>Plant Resources of South-East Asia</i>. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. El Bassam, N (1998) <i>Energy Plant Species: Their Use and Impact on Environment and Development</i>. James & James (Science Publishers) Ltd, London.</p>	<p>1. "Propagated by Bulb: No. Propagated by Corm: No. Propagated by Tubers: No." 2. "Vigorous annual grass, 0.5-5.0 m tall, with one to many tillers, originating from the base or later from stem nodes. Seedling radicle replaced by fibrous adventitious roots emerging from lowest nodes below and immediately above ground level...Stem solid, usually erect." 3. "It has a fibrous root system that branches profusely."; "One of the important factors affecting its drought endurance is the effectiveness of its large fibrous root system."; "Sweet <i>sorghum</i> is</p>

		characterized by a large and widespread root system."
6.01		No evidence.
6.02	<p>1. USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. Pacific Island Ecosystems at Risk (PIER) (2006) PIER Species Information. URL: http://www.hear.org/pier/species/sorghum_bicolor.htm Accessed June 6, 2008. 4. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 5. <i>Sorghum bicolor</i>. URL: http://www.plantzafrica.com/plantqrs/sorghum.htm. Accessed July 15, 2008.</p>	<p>1. "Propagated by Seed: Yes." 2. "The coleoptile emerges from the soil 3-10 days after sowing and leaf emergence follows soon after, with the rate depending largely on temperature."; "<i>Sorghum</i> is normally grown from seed." 3. "Propagation: Seed". 4. "Sweet <i>sorghum</i> is propagated by seed."; "Good seed germination"; "Seed germination occurs within 24 hours in warm and moist soil." 5. "<i>Sorghum</i> is planted from seed, usually in rows in spring."</p>
6.03	<p>1. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York. 2. Doggett, H (1988) <i>Sorghum</i>. Longman Scientific & Technical (Essex, England) with John Wiley & Sons, Inc. (New York) and The International Development Research Centre (Canada). 3. Piper JK, Kulakow PA (1994) Seed yield and biomass allocation in <i>Sorghum bicolor</i> and F1 and backcross generations of <i>Sorghum bicolor</i> × <i>Sorghum halepense</i> hybrids. <i>Canadian Journal of Botany-Revue Canadienne de Botanique</i> 72 (4): 468-474. 4. De Wet, MJM, Harlan, JR (1971) The origin and domestication of <i>Sorghum bicolor</i>. <i>Economic Botany</i> 25 (2): 128-135. 5. Reed, JD (1992) Sorghum and millets as forage crops in the semi-arid tropics. Pp. 173-178 in <i>Utilization of Sorghum and Millets</i> (Gomes, MI, et al., eds.) Pantancheru, A.P., India: International Crops Research Institute for the Semi-Arid Tropics.</p>	<p>1. "<i>Sorghum bicolor</i> subsp. <i>arundinaceum</i> is the wild progenitor of the cultivated strains, all of which are treated as <i>S. bicolor</i> subsp. <i>bicolor</i>. These strains tend to lose their distinguishing characteristics if left to themselves. They will also hybridize with subsp. <i>arundinaceum</i>, and these hybrids can backcross to either parent, resulting in plants that may strongly resemble on parent while having some characteristics of the other." 2. "Stabilized weedy derivatives derived from introgression between domesticated grain sorghums and their closest wild relatives."; "Hybrids between <i>S. bicolor</i> and <i>S. halepense</i>: Reference has already been made to the natural occurrence of these hybrids." HOWEVER "Hadley (1953) used male-sterile and hand-emasculated heads to obtain hybrids." 3. "The development of a perennial grain sorghum by crossing tetraploid <i>Sorghum bicolor</i> with wild <i>S. halepense</i> to combine high seed yield with overwintering ability via rhizome production." [Note: Not occurring in the wild] 4. "It can be</p>

		crossed with all other races and varieties of <i>S. bicolor</i> ;"Hybrids between other cultivated sorghums and members of the wild varieties of <i>S. bicolor</i> resemble race Bicolor in...morphology." 5. "The hybrids of sorghum (<i>Sorghum sudanense</i> x <i>S. bicolor</i>)...may also be useful".
6.04	<i>Sorghum bicolor</i> . URL: http://www.plantzafrica.com/plantqrs/sorghum.htm . Accessed July 15, 2008.	"Self-pollination."
6.05		This is a grass, so pollen is most likely wind dispersed.
6.06	1. USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA. 2. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York. 3. De Wet, JMJ (1978) Systematics and evolution of <i>Sorghum</i> sect. <i>Sorghum</i> (<i>Gramineae</i>). American Journal of Botany 65 (4): 477-485. 4. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 5. <i>Sorghum bicolor</i> . URL: http://www.plantzafrica.com/plantqrs/sorghum.htm . Accessed July 15, 2008.	1. "Vegetative Spread Rate: None." 2. "Without rhizomes." 3. "Plants annual, often tillering." 4. "Each tiller soon develops an independent root system, though it remains attached to the main stem." 5. "Cultivated and most weedy <i>sorghums</i> are non-rhizomatous."
6.07	1. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York. 2. Clayton, WD, et al. (2006 onwards). GrassBase - The Online World Grass Flora. http://www.kew.org/data/grasses-db/www/imp09507.html . [accessed 06 June 2008. 3. Wagner, WL et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 4. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 5. De Wet, JMJ (1978) Systematics and evolution of	1. "Annual or short-lived perennials". 2. "Annual." 3. <i>S. bicolor</i> has robust annuals. 4. "Vigorous annual grass"; "The time to maturity varies greatly among cultivars, some early types taking only 100 days or less, whereas long-duration <i>sorghums</i> require 5-7 months." 5. "Plants annual, often tillering." 6. " <i>Sorghum</i> is mostly grown as an annual, but it is originally a perennial plant." 7. "Duration: Annual." 8. "Annual". 9. "Annuals". 10. "Annual." 11. "Annual." 12. "Most cultivars are annuals, few are perennials." 13. "Plants annual."

	<p>Sorghum sect. Sorghum (<i>Gramineae</i>). American Journal of Botany 65 (4): 477-485.</p> <p>6. Rehm, S, Espig, G (1991) The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilization. Verlag Josef Margraf Scientific Books, Netherlands.</p> <p>7. USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.</p> <p>8. Howard, R. (1974) Flora of the lesser Antilles: Leeward and Windward Islands. Jamaica Plain, Mass. Arnold Arboretum, Harvard University.</p> <p>9. <i>Sorghum bicolor</i> in <i>Gramineae (Poaceae)</i> in Flora of Taiwan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=1050&taxon_id=200026333. Accessed July 15, 2008.</p> <p>10. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008.</p> <p>11. Clayton, WD, et al. (2008). GrassBase - The Online World Grass Flora. URL: http://www.kew.org/data/grasses-db.html. Accessed July 15, 2008.</p> <p>12. <i>Sorghum bicolor</i>. URL: http://www.plantzafrica.com/plantqrs/sorghum.htm. Accessed July 15, 2008.</p> <p>13. Doggett, H (1988) Sorghum. Longman Scientific & Technical (Essex, England) with John Wiley & Sons, Inc. (New York) and The International Development Research Centre (Canada).</p>	
7.01		
7.02	<p>1. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network- (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?35092 Accessed June 2, 2008.</p> <p>2. Barkworth, ME, et al., eds. (2003) Flora of North America: North of Mexico. Oxford University Press, New York.</p> <p>3. Grubben, GJH, Partohardjono, S, eds. (1996). Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers,</p>	<p>1. "Other: cultivated throughout tropic, subtropic, & warm-temperate regions; naturalized in South, Central, & North America, Australia, & India." 2. "<i>Sorghum bicolor</i> is widely cultivated, being used as a grain, for syrup, and as a flavoring for beer.;" "<i>Sorghum bicolor</i> was domesticated in Africa 3000 years ago, reached northwestern India before 2500 B.C., and became an important crop in China after the Mongolian conquest. It was introduced to the Western Hemisphere in the early sixteenth century, and is now an important crop in the United States and</p>

	<p>Leiden, The Netherlands. 4. El Bassam, N (1998) Energy Plant Species: Their Use and Impact on Environment and Development. James & James (Science Publishers) Ltd, London. 5. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008. 6. <i>Sorghum bicolor</i> in Flora of Pakistan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=200026333. Accessed July 15, 2008. 7. <i>Sorghum bicolor</i> Northern Sugar Cane from B & T World Seeds. URL: http://www.b-and-t-world-seeds.com/carth.asp?species=Sorghum%20bicolor&sref=5508. Accessed July 15, 2008.</p>	<p>Mexico." 3. "It was probably distributed from this centre of origin along shipping and trade routes through the Middle East to India at least 3000 years ago. From there, it is thought to have been carried to China along the silk route and through coastal shipping to Burma (Myanmar) and other parts of South-East Asia."; "Husbandry: <i>Sorghum</i> is usually grown as a rainfed crop, sown after the onset of the monsoon season." 4. "Grain <i>sorghum</i>, grown for grain production, is the most important. It is extensively cultivated in several African countries, certain regions of India and in the USA." 5. "<i>Sorghum bicolor</i> is the important, tropical cereal sorghum. Originating in Africa, its cultivation for both grain and fodder spread throughout the tropics and subtropics of the Old World. It was introduced with the slave trade to America, including warm parts of the United States. It is now cultivated throughout most of China." 6. "The cultivated Sorghum is grown as a crop in Sind, Punjab, Lower Baluchistan and the Punjab foothills." 7. <i>Sorghum bicolor</i> seeds are for sale online.</p>
7.03		No evidence.
7.04	<p>1. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 2. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. <i>Sorghum bicolor</i> in <i>Gramineae (Poaceae)</i> in Flora of Taiwan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=1050&taxon_id=200026333. Accessed July 15, 2008. 4. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008.</p>	<p>1. "Caryopsis...broadly ovoid to globose, ca. 4 mm long, ca. 3.5 mm wide, somewhat dorsiventrally compressed, styles persistent." 2. "Fruit a caryopsis, usually partially covered by glumes, rounded and bluntly pointed, 4-8 mm in diameter and varying in size, shape and colour." 3. "Caryopsis 2 mm long; embryo 1/3 the length of the grain." 4. "Caryopsis large, often exposed between the gaping glumes." [no evidence of adaptations to wind dispersal].</p>
7.05		
7.06		

7.07	<p>1. Wagner, WL, et al. (1999) Manual of the Flowering Plants of Hawaii. Revised edition. Bernice P. Bishop Museum special publication. University of Hawai'i Press/Bishop Museum Press, Honolulu. 2. Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands. 3. <i>Sorghum bicolor</i> in <i>Gramineae (Poaceae)</i> in Flora of Taiwan @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=1050&taxon_id=200026333. Accessed July 15, 2008. 4. <i>Sorghum bicolor</i> in Flora of China @ efloras.org. URL: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333. Accessed July 15, 2008.</p>	<p>1. "Caryopsis...broadly ovoid to globose, ca. 4 mm long, ca. 3.5 mm wide, somewhat dorsiventrally compressed, styles persistent." 2. "Fruit a caryopsis, usually partially covered by glumes, rounded and bluntly pointed, 4-8 mm in diameter and varying in size, shape and colour." 3. "Caryopsis 2 mm long; embryo 1/3 the length of the grain." 4. "Caryopsis large, often exposed between the gaping glumes." [no evidence of adaptations to external dispersal]</p>
7.08		
8.01	<p>USDA, NRCS (2008) The PLANTS Database (http://plants.usda.gov, 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.</p>	<p>"Fruit/Seed Abundance: High." [Seed production of sweet sorghum is lower than that of grain sorghum (Z. Helsel 2009), but could find no published numbers.]</p>
8.02	<p>Grubben, GJH, Partohardjono, S, eds. (1996) Plant Resources of South-East Asia. No. 10. Cereals. Backhuys Publishers, Leiden, The Netherlands.</p>	<p>The coleoptile emerges from the soil 3-10 days after sowing and leaf emergence follows soon after, with the rate depending largely on temperature.</p>
8.03	<p>1. Ferrell, J.A., MacDonald, G.E. and Brecke, B.J. 2007. Weed Management in Sorghum - 2008. Document SS-AGR-06. Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Available online at http://edis.ifas.ufl.edu/WG002. Accessed 24 March 2009. 2. Ferrell, J.A. 2009. Personal communication.</p>	<p>1. "sorghum will not tolerate many of the herbicides which can be effectively used on corn. The slow seedling growth combined with the limited number of herbicides and low rates which must be used, creates a problem in sorghum weed control." 2. "Postemergence, <i>S. bicolor</i> is easy to kill, regardless if it is sweet, grain, or weedy sorghum. -Corn - nicosulfuron, glyphosate (in RR corn), glufosinate (in LL corn), imazethapyr (in CF corn). -soybeans, peanuts, and cotton - any of the POST grass materials (clethodim, sethoxydim, fluazifop, etc), imazethapyr (peanut and soy only) and of course glyphosate and glufosinate in GMO cotton and soy varieties. Preemergence. The chloroacetanilide family (metolachlor, acetochlor, etc) is excellent, but the dinitroanalins are weaker unless you use</p>

		high rates. However, you can use a seed treatment and render <i>S. bicolor</i> immune to the chloroacetanilides (this is how you can control grassy weeds in grain sorghum).
8.04	1. Rehm, S, Espig, G (1991) <i>The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilization.</i> Verlag Josef Margraf Scientific Books, Netherlands. 2. USDA, NRCS (2008) <i>The PLANTS Database</i> (http://plants.usda.gov , 6 June 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	1. "Some cultivars, including some of the high-yielding hybrids, respond very well to being harvested more than once (ratoon cropping)." 2. "After Harvest Regrowth Rate: Rapid. Coppice Potential: No." [species is an annual, so not likely to benefit from mutilation].
8.05		