

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>Miscanthus × giganteus</i> -- Florida test			
	Question	Answer	Score
1.01	Is the species highly domesticated?	y	-3
1.02	Has the species become naturalised where grown?	n	-1
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)	1	
2.03	Broad climate suitability (environmental versatility)	?	
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	n	-2
3.02	Garden/amenity/disturbance weed	n	0
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	?	
4.05	Toxic to animals	n	0
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		
4.09	Is a shade tolerant plant at some stage of its life cycle	n	0
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		
5.01	Aquatic	n	0
5.02	Grass	y	1
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte		
6.01	Evidence of substantial reproductive failure in native habitat		
6.02	Produces viable seed	n	-1
6.03	Hybridizes naturally		
6.04	Self-compatible or apomictic	n	-1
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative propagation	y	1
6.07	Minimum generative time (years)	2	0
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	n	-1
7.07	Propagules dispersed by other animals (externally)	n	-1
7.08	Propagules dispersed by other animals (internally)	n	-1
8.01	Prolific seed production	n	-1
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	n	-1
8.03	Well controlled by herbicides		
8.04	Tolerates, or benefits from, mutilation or cultivation		
8.05	Effective natural enemies present in Florida, or east of the continental divide		
Total Score			-8

Outcome	Accept
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section	# questions answered	satisfy minimum?
A	11	Yes
B	7	Yes
C	16	Yes
total	34	Yes

Data collected 2008

Question number	Reference	Source data
1.01	Lewandowski, I, et al. (2000) <i>Miscanthus</i> : European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227.	"A sterile hybrid horticultural genotype, <i>Miscanthus</i> × <i>giganteus</i> GREEF et DEU was brought back to Denmark by Aksel Olsen in 1935, and was observed to have exceptionally vigorous growth. Extensive field trials of <i>M. × giganteus</i> GREEF et DEU have been carried out in northern Europe since 1983". [a sterile hybrid known only from cultivation]
1.02	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?455049 (02 June 2008). 2. Jacquart, E, et al. (2007) Assessment of <i>Miscanthus sinensis</i> and <i>Miscanthus</i> × <i>giganteus</i> in Indiana's Natural Areas. Indiana Department of Natural Resources. URL: Http://www.in.gov/dnr/files/official_miscanthus_assessment.pdf . Accessed June 25, 2008.	1. "Distributional range: only cultivated" 2. "There are no reports of <i>Miscanthus</i> × <i>giganteus</i> moving outside of cultivation in Indiana"
1.03		
2.01	1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lgn.tif). 2. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf . Accessed June 5, 2008. 3. Lewandowski, I, et al. (2000) <i>Miscanthus</i> : European experience with a novel	1. The global plant hardiness zones that occur in the cultivated distribution range (Europe) occur in the United States. 2. "Stands at the University of Illinois in Urbana, planted nearly 20 years ago, have survived winters with periods below -10°F without loss." [Corresponds to zone 5b/6a]; "Giant <i>Miscanthus</i> has been widely studied and grown in Europe where it is being used to produce

	<p>energy crop. Biomass and Bioenergy 19: 209-227. 4. Hodkinson, TR, et al. (2002) The use of DNA sequencing (ITS and TRNL-F), AFLP, and fluorescent in situ hybridization to study allopolyploid <i>Miscanthus</i> (<i>Poaceae</i>). American Journal of Botany 89 (2): 279-286. 5. Saylor, Jesse (2008) Giant <i>Miscanthus</i> (<i>Miscanthus</i> 'Giganteus'). In Plant Encyclopedia. MSU board of Trustees, Jesse Saylor, and Network Vista. URL: http://msuplants.com/pd.asp?pid=2442. Accessed July 17, 2008.</p>	<p>biomass to burn for heat and electricity." 3. "Field trials have been established throughout Europe from the Mediterranean to southern Scandinavia"; "Field trials were established in Denmark, Germany, Ireland and the UK to investigate the biomass potential of <i>M. giganteus</i> across northern Europe." 4. "Japan, where <i>M. × giganteus</i> is believed to have originated." 5. "Hardiness zone: USDA Zones 5-9".</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. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf. Accessed June 5, 2008. 3. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. Biomass and Bioenergy 19: 209-227. 4. Hodkinson, TR, et al. (2002) The use of DNA sequencing (ITS and TRNL-F), AFLP, and fluorescent in situ hybridization to study allopolyploid <i>Miscanthus</i> (<i>Poaceae</i>). American Journal of Botany 89 (2): 279-286. 5. Saylor, Jesse (2008) Giant <i>Miscanthus</i> (<i>Miscanthus</i> 'Giganteus'). In Plant Encyclopedia. MSU board of Trustees, Jesse Saylor, and Network Vista. URL: http://msuplants.com/pd.asp?pid=2442. Accessed July 17, 2008.</p>	<p>1. Most likely only two climatic groups, but cultivated distribution range is not specific enough to determine. 2. "Stands at the University of Illinois in Urbana, planted nearly 20 years ago, have survived winters with periods below -10°F without loss." [Corresponds to zone 5b/6a]; "Giant <i>Miscanthus</i> has been widely studied and grown in Europe where it is being used to produce biomass to burn for heat and electricity." 3. "Field trials have been established throughout Europe from the Mediterranean to southern Scandinavia"; "Field trials were established in Denmark, Germany, Ireland and the UK to investigate the biomass potential of <i>M. giganteus</i> across northern Europe." 4. "Japan, where <i>M. × giganteus</i> is believed to have originated." 5. "Hardiness zone: USDA Zones 5-9".</p>
2.04	<p>1. Atlapedia Online (http://www.atlapedia.com/online/countries/denmark.htm). 2. Atlapedia Online (http://www.atlapedia.com/online/countries/germany.htm). 3. Atlapedia Online (http://www.atlapedia.com/online/countries/ireland.htm). 4. Atlapedia Online (http://www.atlapedia.com/online/countries/unitedkingdom.htm). 5. MSN Encarta (http://encarta.msn.com/encyclopedia_761566679_4/Japan.html). 6. Saylor, Jesse. (2008) Giant <i>Miscanthus</i> (<i>Miscanthus</i> 'Giganteus'). In Plant Encyclopedia. MSU board of Trustees, Jesse Saylor, and Network Vista. URL:</p>	<p>1. For Denmark: average annual precipitation is 600 mm (24 inches). 2. For Germany: average annual precipitation in Berlin is 592 mm (23 inches). 3. For Ireland: Rainfall is heaviest in the west where it can exceed 3,000 mm (120 inches) per annum while 60% of the country has an average annual precipitation between 762 mm and 1,270 mm (30 and 50 inches). 4. For the U.K.: average annual precipitation varies from 1,600 mm (63 inches) in the mountainous areas of the north and west to less than 800 mm (32</p>

	<p>http://msuplants.com/pd.asp?pid=2442. Accessed July 17, 2008.</p>	<p>inches) over central and eastern areas. 5. For Japan: average annual precipitation in Sapporo [north] is 1,130 mm (45 in), while in Tokyo [central] it is 1,410 mm (55 in) and in Kagoshima [south] it is 2,240 mm (88 in). 6. "In wet areas of the landscape."</p>
2.05	<p>1. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227. 2. Jorgensen, U, Schwarz, KU (2000) Why do basic research? A lesson from commercial exploitation of <i>Miscanthus</i>. <i>New Phytologist</i> 148 (2): 190-193. 3. Hodkinson, TR, et al. (2002) The use of DNA sequencing (ITS and TRNL-F), AFLP, and fluorescent in situ hybridization to study allopolyploid <i>Miscanthus</i> (Poaceae). <i>American Journal of Botany</i> 89 (2): 279-286. 4. <i>Miscanthus x giganteus</i> at Binny Plants. URL: http://www.binnyplants.co.uk/catalogue.php?show=1687&cat1=1. Accessed June 25, 2008. 5. Jones, MB, Walsh, M (2001) <i>Miscanthus</i> for Energy and Fibre. James & James (Science Publishers) Ltd, London.</p>	<p>1. "Field trials were established in Denmark, Germany, Ireland and the UK to investigate the biomass potential of <i>M. giganteus</i> across northern Europe." 2. "<i>M. x giganteus</i> was introduced as an ornamental plant to Europe in the 1930s." 3. "<i>Miscanthus x giganteus</i> was introduced to Denmark from Japan as an ornamental in 1935, and it is probable that rhizomes-propagated clones used in agricultural field trials originated from this horticultural introduction." 4. For sale in Scotland at Binny Plants nursery. 5. "<i>Miscanthus x giganteus</i>...originated in southeast Asia and was initially imported to Europe as an ornamental plant." [This species is man-made and thus does not have a native range, but it has been widely introduced].</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?455049 (02 June 2008). 2. Jacquart, E, et al. (2007) Assessment of <i>Miscanthus sinensis</i> and <i>Miscanthus x giganteus</i> in Indiana's Natural Areas. Indiana Department of Natural Resources. URL: Http://www.in.gov/dnr/files/official_miscanthus_assessment.pdf. Accessed June 25, 2008.</p>	<p>1. "Distributional range: only cultivated" 2. "There are no reports of <i>Miscanthus x giganteus</i> moving outside of cultivation in Indiana"</p>
3.02		No evidence
3.03		No evidence
3.04		No evidence
3.05	<p>1. Holm, L. et al. (1979) <i>A Geographical Atlas of World Weeds</i>. John Wiley and Sons, New York.</p>	<p>1. <i>Miscanthus japonicus</i> is a serious weed of agriculture in Western</p>

	2. Meyer, MH, Tchida, CL (1999) <i>Miscanthus Anderss.</i> produces viable seed in four USDA hardiness zones. <i>Journal of Environmental Horticulture</i> 17 (3): 137-140.	Polynesia. 2. "In Western North Carolina (Zone 6), large stands of self-seeded, naturalized <i>Miscanthus</i> have established in disturbed areas along roadsides."
4.01		No description of these traits.
4.02		
4.03		No description of parasitism.
4.04	Heaton, E, et al. (2004) A quantitative review comparing the yields of two candidate C4 perennial biomass crops in relation to nitrogen, temperature and water. <i>Biomass and Bioenergy</i> 27: 21-30.	alternative use as forage: no
4.05		No evidence.
4.06	1. El Bassam, N. (1998) Energy plant species : their use and impact on environment and development. James & James. 2. Jones, MB, Walsh, M (2001) <i>Miscanthus</i> for Energy and Fibre. James & James (Science Publishers) Ltd, London.	1. "In its native habitats <i>Miscanthus</i> falls victim to a number of diseases, but in the areas where it has been relocated it has not yet shown much sign of being attacked by pathogens. <i>Miscanthus</i> has already proven itself to be quite resistant against diseases, but the more miscanthus is bred and grown throughout Europe and the Mediterranean region, the greater the chance of it being attacked by diseases already common to these areas. Diseases that attack or are likely candidates for attacking <i>Miscanthus</i> in its native habitats can be grouped into Uridinales (rusts), Ustilaginales (smuts), Sphaeropsidales, Clavicipitales, Hyphomycetes, Peronosporaceae (downy mildews) and Pythiaceae. <i>Miscanthus</i> has been shown to be attacked by one virus disease, <i>Miscanthus</i> streak virus." [genus information] 2. "Low susceptibility to pests and diseases."
4.07		No evidence
4.08		
4.09	Saylor, Jesse (2008) Giant <i>Miscanthus</i> (<i>Miscanthus</i> 'Giganteus'). In Plant Encyclopedia. MSU board of Trustees, Jesse Saylor, and Network Vista. URL:	"Grow in full sun".

	http://msuplants.com/pd.asp?pid=2442 . Accessed July 17, 2008.	
4.10	1. El Bassam, N (1998) Energy plant species : their use and impact on environment and development. James & James. 2. Saylor, Jesse (2008) Giant <i>Miscanthus</i> (<i>Miscanthus</i> 'Giganteus'). In Plant Encyclopedia. MSU board of Trustees, Jesse Saylor, and Network Vista. URL: http://msuplants.com/pd.asp?pid=2442 . Accessed July 17, 2008.	1. " <i>Miscanthus</i> does not make many demands on the soil, a fact demonstrated by its ability to grow on many types of arable land. Sands and sandy loams consisting of up to 10% of clay have shown to be the preferred soil types...Success on sands and very stony soil is dependent on sufficient rainfall. A good yield has also been experienced on well drained soils with high humus."; "Soils of greater than 25% clay probably unsuitable." [genus information] 2. "Grow in...average, moist, well-drained soil."
4.11	1. Hodkinson, TR, Renvoize, SA (2001) Nomenclature of <i>Miscanthus</i> × <i>giganteus</i> (<i>Poaceae</i>). Kew Bulletin 56: 759–760. 2. Hong, J, Meyer, M (2007) Effect of medium, date, and node position on rooting of <i>Miscanthus</i> × <i>giganteus</i> stem cuttings. HortScience 42 (4): 910. 3. Heaton, E, et al. (2004) A quantitative review comparing the yields of two candidate C4 perennial biomass crops in relation to nitrogen, temperature and water. Biomass and Bioenergy 27: 21-30.	1. "Culms erect, 200 cm high, 5-10 mm diameter, solid, unbranched." 2. "A large perennial ornamental grass." 3. "Perennial rhizomatious grass species".
4.12		
5.01		Terrestrial.
5.02	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?455049 (02 June 2008).	Poaceae
5.03	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?455049 (02 June 2008).	Poaceae
5.04		
6.01		
6.02	1. Lewandowski, I, et al. (2000) <i>Miscanthus</i> :	1. "As a consequence of its triploidy, <i>M.</i>

	European experience with a novel energy crop. Biomass and Bioenergy 19: 209-227. 2. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf . Accessed June 5, 2008. 3. Hong, J, Meyer, M (2007) Effect of medium, date, and node position on rooting of <i>Miscanthus</i> × <i>giganteus</i> stem cuttings. HortScience 42(4): 910. 4. Meyer, MH, Tchida, CL (1999) <i>Miscanthus Anderss</i> . Produces viable seed in four USDA hardiness zones. Journal of Environmental Horticulture 17 (3): 137-140. 5. Jorgensen, U, Schwarz, KU (2000) Why do basic research? A lesson from commercial exploitation of <i>Miscanthus</i> . New Phytologist. 148 (2): 190-193.	× <i>giganteus</i> is sterile and cannot form fertile seeds." 2. "Giant <i>Miscanthus</i> is sterile"; "Is unable to produce viable seed." 3. " <i>Miscanthus</i> × <i>giganteus</i> is male sterile and has never been known to set seed." 4. " <i>M.</i> × <i>giganteus</i> are reported to be male sterile or set very little seed." 5. "Sterile, triploid, interspecific hybrid".
6.03		
6.04	Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf . Accessed June 5, 2008.	"Giant <i>Miscanthus</i> is sterile"; "Is unable to produce viable seed." [Unsure whether this species is capable of apomixis or agamospermy]
6.05		grass species
6.06	1. Hodkinson, TR, Renvoize, SA (2001) Nomenclature of <i>Miscanthus</i> × <i>giganteus</i> (<i>Poaceae</i>). Kew Bulletin 56: 759–760. 2. Hodkinson, TR, et al. (2002) The use of DNA sequencing (ITS and TRNL-F), AFLP, and fluorescent in situ hybridization to study allopolyploid <i>Miscanthus</i> (<i>Poaceae</i>). American Journal of Botany 89 (2): 279-286. 3. Greef, JM, Deuter, M (1993) Syntaxonomy of <i>Miscanthus</i> × <i>giganteus</i> Greef et Deu. Angewandte Botanik 67: 87-90. 4. Jones, MB, Walsh, M (2001) <i>Miscanthus</i> for Energy and Fibre. James & James (Science Publishers) Ltd, London.	1. "Base shortly rhizomatous, much-branched." 2. "Can reproduce by vegetative propagation." 3. "Perennial with thick and stout rhizome." 4. " <i>Miscanthus</i> × <i>giganteus</i> is a woody rhizomatous..."
6.07	El Bassam, N. (1998) Energy plant species: their use and impact on environment and development. James & James.	"the crop usually does not reach maturity until after 2-3 years" [genus]
7.01		
7.02	1. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf . Accessed	1. "Giant <i>Miscanthus</i> has been widely studied and grown in Europe where it is being used to produce biomass to burn for heat and electricity." 2. "Field trials

	<p>June 5, 2008. 2. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227. 3. Meyer, MH and Tchida, CL (1999) <i>Miscanthus Anderss.</i> produces viable seed in four USDA hardiness zones. <i>Journal of Environmental Horticulture</i> 17 (3): 137-140. 4. Jones, MB, Walsh, M (2001) <i>Miscanthus</i> for Energy and Fibre. James & James (Science Publishers) Ltd, London.</p>	<p>were established in Denmark, Germany, Ireland and the UK to investigate the biomass potential of <i>M. giganteus</i> across northern Europe." 3. "M. x giganteus was introduced as an ornamental plant to Europe in the 1930s." 4. "Initially imported to Europe as an ornamental plant."</p>
7.03		No evidence
7.04	<p>1. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf. Accessed June 5, 2008. 2. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227.</p>	<p>1. "Giant Miscanthus is sterile"; "Is unable to produce viable seed." 2. "As a consequence of its triploidy, M. x giganteus is sterile and cannot form fertile seeds." [No evidence of viable seeds being produced]</p>
7.05		
7.06	<p>1. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf. Accessed June 5, 2008. 2. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227.</p>	<p>1. "Giant Miscanthus is sterile"; "Is unable to produce viable seed." 2. "As a consequence of its triploidy, M. x giganteus is sterile and cannot form fertile seeds." [No evidence of viable seeds being produced]</p>
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7.08	<p>1. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf. Accessed June 5, 2008. 2. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227.</p>	<p>1. "Giant Miscanthus is sterile"; "Is unable to produce viable seed." 2. "As a consequence of its triploidy, M. x giganteus is sterile and cannot form fertile seeds." [No evidence of viable seeds being produced]</p>

8.01	<p>1. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf. Accessed June 5, 2008. 2. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227.</p>	<p>1. "Giant <i>Miscanthus</i> is sterile"; "Is unable to produce viable seed." 2. "As a consequence of its triploidy, <i>M. × giganteus</i> is sterile and cannot form fertile seeds." [No evidence of viable seeds being produced]</p>
8.02	<p>1. Pyter, R, et al. Growing Giant <i>Miscanthus</i> in Illinois. URL: Http://www.miscanthus.uiuc.edu/wp-content/uploads/growersguide.pdf. Accessed June 5, 2008. 2. Lewandowski, I, et al. (2000) <i>Miscanthus</i>: European experience with a novel energy crop. <i>Biomass and Bioenergy</i> 19: 209-227.</p>	<p>1. "Giant <i>Miscanthus</i> is sterile"; "Is unable to produce viable seed." 2. "As a consequence of its triploidy, <i>M. × giganteus</i> is sterile and cannot form fertile seeds." [No evidence of viable seeds being produced]</p>
8.03		
8.04		
8.05		