

**Australia/New Zealand Weed Risk Assessment adapted for Florida.**

**Data used for analysis published in: Gordon, D.R., D.A. Onderdonk, A.M. Fox, R.K. Stocker, and C. Gantz. 2008. Predicting Invasive Plants in Florida using the Australian Weed Risk Assessment. Invasive Plant Science and Management 1: 178-195.**

<i>Amaranthus spinosus (spiny amaranth)</i>			
Question number	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 periodic inundation	?	
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	y	0
3.02	Garden/amenity/disturbance weed	?	
3.03	Weed of agriculture	y	0
3.04	Environmental weed	n	0
3.05	Congeneric weed	y	0
4.01	Produces spines, thorns or burrs	y	1
4.02	Allelopathic	y	1
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	?	
4.05	Toxic to animals	y	1
4.06	Host for recognised pests and pathogens	y	1
4.07	Causes allergies or is otherwise toxic to humans	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	n	0
4.1	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	n	0

5.01	Aquatic	n	0
5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat		
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally		
6.04	Self-compatible or apomictic		
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	?	
7.03	Propagules likely to disperse as a produce contaminant	n	-1
7.04	Propagules adapted to wind dispersal	y	1
7.05	Propagules water dispersed	y	1
7.06	Propagules bird dispersed	y	1
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	y	1
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	y	1
8.03	Well controlled by herbicides	y	-1
8.04	Tolerates, or benefits from, mutilation or cultivation		
8.05	Effective natural enemies present in Florida, or east of the continental divide		
<b>Total Score</b>			<b>18</b>

<b>Outcome</b>	<b>Reject*</b>
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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	6	yes
B	11	yes
C	17	yes
total	34	yes

Data collected 2006-2007

Question number	Reference	Source data
1.01	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	"Nowadays it is rarely cultivated."
1.02		
1.03		
2.01	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	" <i>A. spinosus</i> occurs in all tropical and subtropical regions, including the whole of South-East Asia...It is sometimes found in temperate regions as well."
2.02		
2.03	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	" <i>A. spinosus</i> occurs in all tropical and subtropical regions, including the whole of South-East Asia...It is sometimes found in temperate regions as well."
2.04	1. Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden. 2. Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	1. "Optimal growth is obtained on soils with moderate moisture content, but spiny amaranth is capable of growing on wet soils as well." 2. "The plant will grow both in dry and wet sites but prospers when soil moisture levels are below field capacity. Waterlogging retards its growth."
2.05	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	"It has been suggested that spiny amaranth originates from lowland tropical South and Central America, and that it was introduced in other warmer parts of the world from about 1700 AD onwards."
3.01	1. Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden. 2. New Zealand Plant Conservation Network (2005) New Zealand Adventive	1. "In South-East Asia, it is very common in roadsides, waste places, railway yards, cropped land and gardens" 2. fully naturalized in New Zealand

	Vascular Plant List.	
3.02	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	"In South-East Asia, it is very common in roadsides, waste places, railway yards, cropped land and gardens" [unclear whether it is intrusive]
3.03	1. Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu. 2. Waterhouse (1997) The major invertebrate pests and weeds of agriculture and plantation forestry in the southern and western Pacific. ACIAR Monograph No. 44, 99p.	1. "Forty-four countries report it as a weed in 28 world crops." 2. Considered a major weed of agriculture (vegetables) in the Pacific.
3.04		no evidence
3.05	Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	<i>A. retroflexus</i> and <i>A. viridis</i> are two of the most widely distributed weed species in the arable crops of the world.
4.01	Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	" <i>Amaranthus spinosus</i> ...bears a pair of diverging, stipular spines almost as sharp and rigid as needles at the base of each leaf."
4.02	Connick, Bradow, and Legendre (1989) Identification and bioactivity of volatile allelochemicals from amaranth residues. Journal of Agricultural and Food Chemistry 37: 792-796.	Volatile organic compounds from amaranth residues inhibited germination of several crop species.
4.03	Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	no description of this
4.04	1. Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu. 2. Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	1. "The plant is avoided by most stock animals because of the spines." BUT 2. "In Indo-China and India, spiny amaranth is used as forage...Spiny amaranth is browsed by sheep and goats and is a highly nutritious feed at any time during the year."
4.05	1. Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu. 2. Peixoto, Brust, Brito, Franca, da Cunha, and de Andrade (2003) <i>Amaranthus spinosus</i> (Amaranthaceae) poisoning in sheep in southern Brazil. Pesquisa Veterinaria Brasileira 23: 179-184. 3. Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	1. " <i>A. spinosus</i> was implicated in a case of livestock poisoning" 2. "An outbreak of acute poisoning caused by <i>Amaranthus spinosus</i> is described in ewes of southern Brazil." BUT 3. "In Indo-China and India, spiny amaranth is used as forage...Spiny amaranth is browsed by sheep and goats and is a highly nutritious feed at any time during the year."
4.06	1. Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu. 2. Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	1. " <i>A. spinosus</i> is an alternate host of <i>Meloidogyne incognita</i> ...and of the viruses which produce tobacco mosaic and groundnut rosette." 2. "When the world's worst weeds are ranked on the basis of the

		number of pests hosted, spiny amaranth is placed number 6, hosting 15 pests that may affect crops."
4.07	1. Holm, Plucknett, Pancho, and Herberger (1977) <i>The World's Worst Weeds: Distribution and Biology</i> . The University Press of Hawaii, Honolulu. 2. Padua, Bunyaphatsara, and Lemmens, eds. (1999) <i>Plant Resources of South-East Asia</i> . No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	1. "Leaves are sometimes used as vegetable greens." 2. " <i>A. spinosus</i> pollen may cause hay fever, but the reaction is usually milder than that caused by some grass pollen." [sounds fairly minor]
4.08		no evidence
4.09	Holm, Plucknett, Pancho, and Herberger (1977) <i>The World's Worst Weeds: Distribution and Biology</i> . The University Press of Hawaii, Honolulu.	"The plants do not grow well in shade"
4.1	Padua, Bunyaphatsara, and Lemmens, eds. (1999) <i>Plant Resources of South-East Asia</i> . No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	"It is nitrophilous and prefers soils with a high organic matter content, but is also able to grow on sandy soils."
4.11	USDA, NRCS. 2005. The PLANTS Database, Version 3.5 ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> ). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	growth habit: forb/herb
4.12	Padua, Bunyaphatsara, and Lemmens, eds. (1999) <i>Plant Resources of South-East Asia</i> . No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	an herb, to 100 cm tall (but often occurs gregariously)
5.01		terrestrial
5.02	USDA, NRCS. 2005. The PLANTS Database, Version 3.5 ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> ). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	Amaranthaceae
5.03	USDA, NRCS. 2005. The PLANTS Database, Version 3.5 ( <a href="http://plants.usda.gov">http://plants.usda.gov</a> ). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.	herbaceous Amaranthaceae
5.04	Mohlenbrock (2001) <i>Flowering Plants: Pokeweeds, Four-o'clocks, Carpetweeds, Cacti, Purslanes, Goosefoots, Pigweeds, and Pinks</i> . Southern Illinois University Press.	"annual monoecious herb from a deep taproot"
6.01		
6.02	Holm, Plucknett, Pancho, and Herberger (1977) <i>The World's Worst Weeds: Distribution and Biology</i> . The University Press of Hawaii, Honolulu.	" <i>A. spinosus</i> is propagated by seeds"
6.03		
6.04		
6.05	Paredes-Lopez, ed. (1994) <i>Amaranth Biology, Chemistry, and Technology</i> . CRC Press, Boca Raton.	"Pollination [of the genus <i>Amaranthus</i> ] is anemophilous."
6.06	Paredes-Lopez, ed. (1994) <i>Amaranth Biology, Chemistry, and Technology</i> . CRC Press, Boca Raton.	"Amaranths are annual plants that establish every year from seeds."
6.07	Holm, Plucknett, Pancho, and Herberger (1977) <i>The World's Worst Weeds: Distribution and Biology</i> . The University Press of Hawaii, Honolulu.	annual

7.01		
7.02	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	"it was introduced into other warmer parts of the world from about 1700 AD onwards. Nowadays it is rarely cultivated." [so it used to be cultivated?]
7.03		no evidence
7.04	Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	Seeds "dispersed principally by wind and water".
7.05	Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	Seeds "dispersed principally by wind and water".
7.06	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	Seeds "are scattered around the mother plants or distributed by animals feeding on the plants...Seeds are eaten by birds."
7.07		no evidence of any means of attachment
7.08	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	Seeds "are scattered around the mother plants or distributed by animals feeding on the plants. It has been observed that large numbers of seedlings emerge from decaying cattle faecal deposits."
8.01	Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	"Some types are known to produce 235,000 seeds per plant." [and plant only about 1 m high]
8.02	Holm, Plucknett, Pancho, and Herberger (1977) The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu.	Seeds have a long viability; "Seeds stored in glass containers for 19 years still gave 4-percent germination." [not in soil...]
8.03	Padua, Bunyaphatsara, and Lemmens, eds. (1999) Plant Resources of South-East Asia. No. 12. Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.	"As a weed in tomato in India spiny amaranth has been successfully controlled by the application of geraniol, which completely blocked the germination of the weed without affecting the tomato crop."
8.04		
8.05		