Taxon: Amaranthus spinosus L. **Family:** Amaranthaceae

Common Name(s): carelessweed
edlebur
needlebur
prickly amaranth
spiny amaranth
spiny pigweed
thorny amaranth
thorny pigweed

Synonym(s):

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 16 Mar 2016

WRA Score: 20.0 **Designation:** H(Hawai'i) **Rating:** High Risk

Keywords: Annual Crop Weed, Spiny, Allergen, Wind-Dispersed, Water-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed		
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic	y=1, n=0	y
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n

Qsn #	Question	Answer Option	Answer
405	Toxic to animals	y=1, n=0	y
406	Host for recognized pests and pathogens	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	y
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets		
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people	y=1, n=-1	n
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	[No evidence] "Amaranthus spinosus originates probably from lowland tropical South and Central America and was introduced into other warmer parts of the world from about 1700 AD onwards. At present it occurs in all tropical and subtropical regions, including tropical Africa, often gregariously and as a weed. It is sometimes found in temperate zones as well. It is rarely cultivated."

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus originates probably from lowland tropical South and Central America and was introduced into other warmer parts of the world from about 1700 AD onwards. At present it occurs in all tropical and subtropical regions, including tropical Africa, often gregariously and as a weed. It is sometimes found in temperate zones as well."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus is adapted to a wide range of climatic and edaphic factors." ... "In general, it is very common in roadsides, waste places, railway yards, cropped land and gardens, up to 1400 m altitude."

Qsn #	Question	Answer
204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus originates probably from lowland tropical South and Central America and was introduced into other warmer parts of the world from about 1700 AD onwards."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i naturalized and often common in low elevation, disturbed sites on Kure Atoll and documented from all of the main islands except Ni'ihau and Lana'i. Naturalized prior to 1928 (Neal & Metzger, 1928)."

Qsn #	Question	Answer
205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus originates probably from lowland tropical South and Central America and was introduced into other warmer parts of the world from about 1700 AD onwards. At present it occurs in all tropical and subtropical regions, including tropical Africa, often gregariously and as a weed."

Qsn #	Question	Answer
301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A. spinosus is a native of tropical America and is found mainly in warm areas. It extends into the temperate zone in Japan and the USA. It is a problem weed principally around the Caribbean Sea, the west and south of Africa, around the Bay of Bengal and in East and South-East Asia from Japan to Indonesia. With minor exceptions its range extends from latitude 30°N to 30°S (Holm et al., 1991)."
	Starr, F., Martz, K., & Loope, L.L. 2002. New plant records from the Hawaiian archipelago. Bishop Museum Occasional Papers. 69:16-27	"Amaranthus spinosus (spiny amaranth) is naturalized and often common in low elevation, disturbed sites on Kure Atoll and documented from all the main islands except Ni'ihau and Länai (Wagner et al., 1999: 188). On Midway, it was observed growing out of open fields in two distinct localities on Sand Island. This collection represents a new island record for Midway Atoll. Material examined. MIDWAY ATOLL: Sand I, cemetery by demolished6000 housing, small patch of plants growing out of occasionally mowed area, near sea level, 7 May 1999, Starr & Martz 990507-2."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i naturalized and often common in low elevation, disturbed sites on Kure Atoll and documented from all of the main islands except Ni'ihau and Lana'i. Naturalized prior to 1928 (Neal & Metzger, 1928)."

Qsn #	Question	Answer
302	**Garden/amenity/disturbance weed**	
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	[Primarily an agricultural pest] "In South-East Asia, it is very common in roadsides, waste places, railway yards, cropped land and gardens, up to 1400 m altitude."

303	Agricultural/forestry/horticultural weed	y
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A troublesome weed in pastures, rangelands, waste places, and cultivated areas." ... "A prolific seeder which crowds out forage grass. Avoided by livestock because of its long sharp spines."
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A. spinosus is reported to be the number three weed in maize in the Philippines as well as a principal weed in that crop in Ghana, Hawaii, Mexico and Thailand, and a common weed in Malaysia and Taiwan. In cotton, it is ranked number one in Thailand, principal in Nicaragua and the USA, and as a common weed in Mozambique. In groundnuts, it is a principal weed in Ghana, Hawaii, the Philippines and the USA. In sugarcane, it is a principal weed in Brazil, South Africa and Taiwan and a common weed in Hawaii, India, Indonesia and Peru. In upland rice, A. spinosus is the principal weed in Mexico and the Philippines, and a common weed in Sri Lanka, India and Indonesia (Holm et al., 1991). A. spinosus is a principal weed of mangoes, sorghum, soyabeans and cowpeas in the Philippines; tobacco in Taiwan, beans in Mexico, vegetables in Malaysia, oil palms in Indonesia, papayas and sweet potatoes in Hawaii, mulberries in Japan, and cassava in Ghana. It is a common weed of bananas in Taiwan, oil palms in Nicaragua, pineapples in Hawaii, vegetables in Brazil, Ghana, Hawaii, India, the Philippines and the USA, and of tea and jute in Taiwan. It is found in millet in the Philippines, coffee in Angola and El Salvador, and pineapples in the Philippines (Holm et al., 1991)."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Spiny amaranth is a very noxious weed in many parts of the world. It is, for instance, troublesome in maize, cassava and groundnut in Ghana, in cotton in Mozambique, and in sugar cane in South Africa."

304	Environmental weed	n
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A troublesome weed in pastures, rangelands, waste places, and cultivated areas."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"In general, it is very common in roadsides, waste places, railway yards, cropped land and gardens,"
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i naturalized and often common in low elevation, disturbed sites"

Qsn #	Question	Answer
	Loope, L.L., Nagata, R.J. & Medeiros, A.C. 1992, Alien plants in Haleakala National Park Pp. 551-576 in Stone et al (eds) Alien plant invasions in native ecosystems of Hawaii. Coop. Nat. Park Resources Studies Unit, University of Hawaii, Honolulu, HI	"Table 2. Plant species introduced to the western slope of Haleakala in 1976-81 during widening and resurfacing of Haleakala Highway.* As of April 1991, only Vicia sativa persists." [Amaranthus spinosus introduced along roadsides]

305	Congeneric weed	y
	Source(s)	**Notes**
	CABI, 2016. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	A number of other Amaranthus species are documented as weeds including the following: Amaranthus blitum, Amaranthus dubius, Amaranthus hybridus, Amaranthus retroflexus, Amaranthus tuberculatus, and Amaranthus viridis

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Monoecious annual herbs; stems sometimes tinged with red, erect, sometimes ascending, 4-15 dm long, usually branched, striate, glabrous or pubescent with multi-cellular hairs, especially above, most leaf axils with a pair of divergent spines up to 2.5 cm long. Leaves ovate to rhombic-ovate, elliptic, lanceolate-oblong, or lanceolate, blades 1-12 cm long, 0.89-6 cm wide, glabrous, lower surface occasionally sparsely pilose, especially along the veins, petioles 1-9 cm long."

402	Allelopathic	y
	Source(s)	**Notes**
	Swain, D., Pandey, P., Paroha, S., Singh, M., & Yaduraju, N. T. (2004). Allelopathic effect of Amaranthus spinosus on Parthenium hysterophorus. Annals of Plant Protection Sciences, 12(2), 403-408	"The allelopathic influence of Amaranthus spinosus on Parthenium hysterophorus were evaluated following standard bioassay and biochemical techniques involving germination and growth of seedlings and mature plants. The aqueous leachates obtained from leaf, stem and root showed strong inhibiting effect on the growth and multiplication of P. hysterophorus. The leaf leachates were most toxic and in higher concentration (20% W/V) reduced the germination of Parthenium by 95%, total chlorophyll content by 82.4% and protein content by 65.5%. Stem leachates reduced germination by 15% and root and shoot growth by 29% and 26%, respectively. Post emergence application of leaf leachates severely affected the growth of Parthenium and wilting and chlorosis of seedlings, was noticed within 24 hrs of application."
	Connick Jr, W. J., Bradow, J. M., & Legendre, M. G. (1989). Identification and bioactivity of volatile allelochemicals from amaranth residues. Journal of Agricultural and Food Chemistry, 37(3), 792-796	Volatile organic compounds from amaranth residues inhibited germination of several crop species.

403	Parasitic	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Monoecious annual herbs; stems sometimes tinged with red, erect, sometimes ascending, 4-15 dm long, usually branched, striate, glabrous or pubescent with multi-cellular hairs, especially above, most leaf axils with a pair of divergent spines up to 2.5 cm long." [Amaranthaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"Avoided by livestock because of its long sharp spines."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	[Palatable, but with associated problems] "Amaranthus spinosus is also used as forage and said to increase the yield of milk in cattle. However, the spines can cause injury to the mouths of grazing animals and cases of poisoning in cattle have also been reported."

405	Toxic to animals	y
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A. spinosus was implicated in a case of livestock poisoning in 1973 when 39 dairy cows died after being fed chopped forage sorghum containing as much as 25-33% (by weight) of the weed. The poisoning was diagnosed as being caused by nitrate, and A. spinosus showed high nitrate levels. Hurst (1942) and Kingsbury (1964) both mention A. spinosus as a suspected poisonous plant."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	[Potentially] "Cases of spontaneous poisoning in cattle by Amaranthus spinosus have been reported, particularly after severe droughts when few other forages were available. It was suggested that Amaranthus spinosus caused renal failure. The roots contain α-spinasterol and some saponins. Sterols, n-alkanes, fatty acids and free alcohols have been found in petroleum-ether extracts of the herb. The flavonoid rutin has been found in the aboveground parts in a concentration of up to 1.9%, and traces of hydrocyanic acid in the leaves. The considerable amount of potassium in the leaves might explain the diuretic properties."

406	Host for recognized pests and pathogens	y
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus is a host plant for, among others, tobacco mosaic virus, groundnut rosette virus, cucumber mosaic virus and root-knot nematodes (Meloidogyne spp.), which attack some commercial crops. When the world's worst weeds are ranked on the basis of the number of pests hosted, Amaranthus spinosus is placed number 6, hosting 15 pests that may affect crops."

407	Causes allergies or is otherwise toxic to humans	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A common cause of hay fever."
	Singh, A. B., & Dahiya, P. (2002). Antigenic and allergenic properties of Amaranthus spinosus pollen-a commonly growing weed in India. Annals of Agricultural and Environmental Medicine, 9(2), 147-152	"Abstract: Amaranthus spinosus (Fam. Amaranthaceae) is an important aeroallergen in India and grows commonly in different parts of the country. In spite of its clinical significance in Type I hypersensitivity disorders, the antigenic and the allergenic properties of the pollen have not been systematically resolved. We investigated antigenic and allergenic properties of 5 pollen samples of Amaranthus spinosus collected from the Delhi area at fortnightly intervals. The protein content did not exhibit statistically significant variability. However, samples collected during the peak flowering season showed higher protein content. Biochemical characterization of samples showed multiple protein fractions by IEF and SDS-PAGE analysis. Samples collected during peak season showed a slightly higher number of bands (22) in the mw range of 14–70 kD. Seven protein fractions of 70, 66, 60, 50, 40, 30 and 14 kD were observed to have IgE binding capabilities and 9 were treated as allergenic. The observations will be helpful in standardizing pollen antigens for diagnosis and immunotherapy in India."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	CABI, 2016. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	Not included among potential impacts

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A. spinosus does not grow well in shade or cool temperatures, because spine development and flowering are suppressed under these conditions."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"It grows best in the sun or in light shade; a light intensity of less than 30% completely suppresses flowering."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus is adapted to a wide range of climatic and edaphic factors." ... "Spiny amaranth is nitrophilous and prefers soils with a high organic matter content, but is also able to grow on sandy soils. Optimal growth is obtained on soils with moderate moisture content, but Amaranthus spinosus is capable of growing on wet soils as well. It is drought-resistant and can even grow under arid conditions."

411	Climbing or smothering growth habit	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Monoecious annual herbs; stems sometimes tinged with red, erect, sometimes ascending, 4-15 dm long, usually branched, striate, glabrous or pubescent with multi-cellular hairs, especially above, most leaf axils with a pair of divergent spines up to 2.5 cm long."

412	Forms dense thickets	
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	[Grows gregariously] "At present it occurs in all tropical and subtropical regions, including tropical Africa, often gregariously and as a weed."

501	Aquatic	n
	Source(s)	**Notes**
	Holm, L.G., Plucknett, D.L., Pancho, J.V. & Herberger, J.P. 1977. The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu	[Terrestrial] "The plant is found in cultivated fields, waste places, roadsides, garbage heaps, and abandoned fields."

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 15 Mar 2016]	Family: Amaranthaceae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Monoecious annual herbs" [Amaranthaceae. No evidence]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Monoecious annual herbs; stems sometimes tinged with red, erect, sometimes ascending, 4-15 dm long, usually branched, striate, glabrous or pubescent with multicellular hairs, especially above, most leaf axils with a pair of divergent spines up to 2.5 cm long."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	[No evidence. Widely distributed] "Amaranthus spinosus originates probably from lowland tropical South and Central America and was introduced into other warmer parts of the world from about 1700 AD onwards. At present it occurs in all tropical and subtropical regions, including tropical Africa, often gregariously and as a weed. It is sometimes found in temperate zones as well."

602	Produces viable seed	y
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus is propagated by seed. Some types are known to produce 235,000 seeds per plant. The weight of 1000 seeds is 140–250 mg."

603	Hybridizes naturally	y
	Source(s)	**Notes**
	Grant, W. F. (1959). Cytogenetic studies in Amaranthus: II. Natural Interspecific hybridization between Amaranthus dubius and A. spinosus. Canadian Journal of Botany, 37(5), 1063-1070.	"Spontaneous triploid hybrids (2n = 49) were discovered between Amaranthus spinosus L. (2n = 34), a diploid species, and A. dubius Mart. ex Thellung (2n = 64) which was found to be a tetraploid. Meiosis in the hybrids was irregular and 15 univalents were most frequently found along with the bivalents pairing apparently allosyndetically (15 I's + 17 II's = 2n = 49) at metaphase I. Univalents were excluded from the telophase nuclei in both meiotic divisions resulting in supernumerary microspores and in a reduction in the mean size of the microspores. Consequently, the triploids were largely sterile and the few undersized seeds produced failed to germinate. Seed weight, seed volume, stomatal size, and pollen grain size were proportional to chromosome number in the parents only, not in their hybrids. Since A. dubius exhibits typical bivalent behavior in synapsis, it is considered to be an allotetraploid in which A. spinosus has been one progenitor. It is suggested that the diploid A. quitensis H. B. K. (2n = 32) might be the other progenitor, but from chromosome number relationships and morphological considerations more than two species may be involved. As a result of the high sterility of the triploids, gene exchange between the parental species must be of a very limited nature."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Murray, M. J. (1940). The genetics of sex determination in the family Amaranthaceae. Genetics, 25(4), 409-431	"All species used in this study are wind-pollinated. The monoecious members are chiefly self-pollinated, although the stigmas of the pistillate flowers are receptive several days prior to the opening of any staminate flowers."
	Useful Tropical Plants Database. 2016. Amaranthus spinosus. http://tropical.theferns.info/viewtropical.php?id=Amaranthus+spinosus. [Accessed 16 Mar 2016]	"Pollinators: Wind, Self Self-fertile: Yes"

605	Requires specialist pollinators	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Information is scanty on pollination in the family, but it seems clear that anemophily is the norm in Amaranthus, and probably many other genera. However, entomophily seems also to play an undoubted part, particularly by bees. Visits have been observed to Celosia argentea f. cristata (Nomia unidentata), Altemanthera sp. (Cerntina, Dialictus), Cladothrix cryptantha (Perdita cladothricis) and Amaranthus spinosus (Melipona)."
	Grant, W. F. (1959). Cytogenetic studies in Amaranthus: II. Natural Interspecific hybridization between Amaranthus dubius and A. spinosus. Canadian Journal of Botany, 37(5), 1063-1070.	"since both species are wind pollinated, hybrids might be expected not only where they grow intermixed but also in pure stands of either species..."

606	Reproduction by vegetative fragmentation	n
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Annual, erect, monoecious herb, up to 100(–130) cm tall" ... "Amaranthus spinosus is propagated by seed. Some types are known to produce 235,000 seeds per plant. The weight of 1000 seeds is 140–250 mg."

607	Minimum generative time (years)	1
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Annual] "Monoecious annual herbs..."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	**Notes**
	CABI, 2016. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"A spinosus is propagated by seeds that have a long viability and that are dispersed principally by wind and water (Holm et al., 1977)."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"In general, it is very common in roadsides, waste places, railway yards, cropped land and gardens, up to 1400 m altitude."
	Loope, L.L., Nagata, R.J. & Medeiros, A.C. 1992, Alien plants in Haleakala National Park Pp. 551-576 in Stone et al (eds) Alien plant invasions in native ecosystems of Hawaii. Coop. Nat. Park Resources Studies Unit, University of Hawaii, Honolulu, HI	"Table 2. Plant species introduced to the western slope of Haleakala in 1976-81 during widening and resurfacing of Haleakala Highway.* As of April 1991, only Vicia sativa persists." [Amaranthus spinosus introduced along roadsides]

702	Propagules dispersed intentionally by people	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"It is rarely cultivated."
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"Native to tropical America. Accidentally introduced to Hawaii about 1900." [No evidence of intentional introduction]

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A troublesome weed in pastures, rangelands, waste places, and cultivated areas." [A common crop weed. Seeds could become a contaminant in cultivated areas]
	Kurokawa, S. (2001). Invasion of exotic weed seeds into Japan, mixed in imported feed grains. Extension Bulletin-Food & Fertilizer Technology Center No. 497. 14 pp	"Recently, many kinds of foreign weeds have caused serious damage to farmers all over Japan. The source of the invasion was grain imported from countries overseas. Numerous foreign weed seeds (such as Abutilon theophrasti, Amaranthus spinosus, Setaria faberi, Myosotis arvensis and Digitaria sanguinalis) mixed in with feed grain have invaded ports and colonized fields. The viability of most foreign weed seeds is not likely to be affected by the processes of invasion. To control such weeds, several chemical and non-chemical methods (such as rotations) have been tried. So far, composting animal wastes is the only effective way of preventing weed seeds from germinating. The future impact of the weed problem and the need for preventing invasions by new foreign weeds are mentioned."
	Chauhan, B. S., & Johnson, D. E. (2009). Germination ecology of spiny (Amaranthus spinosus) and slender amaranth (A. viridis): troublesome weeds of direct-seeded rice. Weed Science, 57(4), 379-385	"Seeds of spiny amaranth were found in 15% of the samples in the agricultural soil in Belize in the humid tropics (Kellman 1974)." ... "Similarly, spiny amaranth was reported in 15 countries in dry direct-seeded rice."

704	Propagules adapted to wind dispersal	y
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A spinosus is propagated by seeds that have a long viability and that are dispersed principally by wind and water (Holm et al., 1977)."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"Propagation: By seed which has long viability. Dispersed by water."

Qsn #	Question	Answer
706	**Propagules bird dispersed**	
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"It has been observed that large numbers of seedlings emerge from decaying cattle faecal deposits. Seeds are eaten by birds." [Birds are presumably acting as seed predators. Survival of viable seeds unknown]

707	**Propagules dispersed by other animals (externally)**	**n**
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A. spinosus is propagated by seeds that have a long viability and that are dispersed principally by wind and water (Holm et al., 1977)." [Although small seeds may also occasionally be externally dispersed]

708	**Propagules survive passage through the gut**	**y**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Seeds mature about one month after flowering. They 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. Seeds are eaten by birds."

801	**Prolific seed production (>1000/m2)**	**y**
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A prolific seeder which crowds out forage grass."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Amaranthus spinosus is propagated by seed. Some types are known to produce 235,000 seeds per plant."

Qsn #	Question	Answer
802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**y**
	Source(s)	**Notes**
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Freshly collected seeds may germinate at temperatures as high as 40°C, with a germination rate of up to 95%. After storage, however, temperature requirements are lower. Seeds stored for one month at room temperature have almost 100% germination, and after 5 months they have approximately 90% germination. When they are stored for one year at 20°C the germination rate will drop to about 50%, but storage at lower temperatures gives a higher rate."
	Holm, L.G., Plucknett, D.L., Pancho, J.V. & Herberger, J.P. 1977. The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu	"Seeds stored in glass containers for 19 years still gave 4-percent germination."
	Royal Botanic Gardens Kew. (2016) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/. [Accessed 16 Mar 2016]	"Storage Behaviour: Orthodox Storage Conditions: Long-term storage under IPGRI preferred conditions at RBG Kew, WP. Oldest collection 13 years; average germination change 98.4 to 94.2%, mean storage period 10 years, 5 collections"

803	**Well controlled by herbicides**	**y**
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A. spinosus is susceptible to most of the standard herbicides used on broad-leaved weeds. These include 2,4-D, EPTC, MCPA, MSMA (methylarsonic acid), acifluorfen, atrazine, bensulfuron, butachlor, chlorthal-dimethyl, dimethametryn, diphenamid, diuron, glyphosate, metribuzin, oxadiazon, oxyfluorfen, paraquat, pendimethalin, propanil and trifluralin (Kostermans et al., 1987; Lorenzi and Jeffery, 1987; Ampong-Nyarko and de Datta, 1991). Ampong-Nyarko and de Datta (1991) indicate resistance to fenoxaprop, piperophos and thiobencarb. It should also be noted that repeated herbicide use has resulted in the development of resistant strains in some species of Amaranthus (Lorenzi and Jeffery, 1987), and the same could occur in A. spinosus. In groundnuts, it is usually controlled with soil-applied herbicides (Grichar, 1994). Post-emergence control can be obtained with acifluorfen alone or in combination with bentazone; lactofen alone, or 2,4-DB alone applied late post-emergence provided more than 80% control when rated early in the season (Grichar, 1994). Lactofen applied early post-emergence and 2,4-DB applied late post-emergence controlled more than 90% late in the season. Imazethapyr controlled 72-90% of A. spinosus, whereas bentazone and pyridate failed to provide adequate control (Grichar, 1994)."
	Nice, G., Johnson, B. & Jordan, T. 2011. Weed Management in Pastures. Spiny Pigweed. Purdue Extension WS-44-W. Purdue University	"Several herbicides have activity on annual pigweeds in grass pastures. It is important to apply herbicides in a timely manner — applying herbicides to large spiny pigweed plants can have disappointing results. Most herbicide labels require the products to be applied to pigweeds that are less than 4 to 6 inches tall, depending on the specific product."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Nice, G., Johnson, B. & Jordan, T. 2011. Weed Management in Pastures. Spiny Pigweed. Purdue Extension WS-44-W. Purdue University	"Mowing can suppress spiny pigweed growth and seed production, but the plant will bounce back and complete its life cycle if mowing is not maintained. In some pastures, fairly beat-up, short spiny pigweed can still produce flowers and thus seeds. One can remove small numbers of plants with a spade or dandelion fork (a tool for cutting weeds just below the soil line). After removing weeds by hand, we recommend bagging and removing them to ensure seeds are not left in the field. Hand removal is impractical for large fields or where there are heavy infestations of the weed."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	CABI, 2016. Amaranthus spinosus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"In Thailand, augmentative releases of Hypolixus truncatulus have resulted in successful control. This beetle may replace the use of herbicides to control occasional infestations (Julien, 1992)."
	Jansen, P.C.M., 2004. Amaranthus spinosus L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands	"Some insects attacking Amaranthus spinosus have been recorded from Mexico: the pyralid Herpetogramma bipunctalis and the curculionid Conotrachelus seniculus. These might be useful for biological control."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad climate suitability & elevation range exceeds 1000 m
• Thrives in tropical climates
• Widely naturalized including all the main Hawaiian Islands
• Crop weed
• Other Amaranthus species are invasive
• Leaf axils with a pair of divergent spines
• Allelopathic
• Can be poisonous to cattle or other grazing animals
• Host of crop pests & pathogens
• Allergenic & cause of hay fever
• Tolerates many soil types
• Reproduces by seeds
• Hybridizes with other Amaranthus species
• Capable of self-pollination
• Annual growth habit
• Seeds dispersed by wind, water, in animal droppings, & as a seed contaminant
• Prolific seed production
• Seeds able to form a persistent seed bank

Low Risk Traits
• Animals may consume plants, despite spines & toxic properties
• Relatively shade intolerant
• Not reported to spread vegetatively
• Herbicides may provide effective control