

Taxon: <i>Crotalaria verrucosa</i> L.	Family: Fabaceae
Common Name(s): blue rattleweed blue-flower rattlepod purple popbush shack-shack tooth-leaf rattlepod warted rattlebox	Synonym(s): <i>Crotalaria acuminata</i> G. Don <i>Crotalaria angulosa</i> Lamarck <i>Crotalaria mollis</i> Weinmann

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 18 Jan 2018
WRA Score: 10.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Annual Herb, Weedy, Toxic, Self-fertile, Autochorous

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	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed		
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		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	y
406	Host for recognized pests and pathogens	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
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	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)		
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	y
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		
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		
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m ²)		
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	y=1, n=-1	n
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
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, Volume 2. Springer-Verlag, Berlin, Heidelberg, New York	[No evidence of domestication] "Said to be cultivated in the tropics as green manure crop (e.g. Taiwan), the wide distribution being based mainly on escapees from experimental cultivations in various countries, used in folk medicine of various countries."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2018. 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
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 17 Jan 2018]	"Native: Asia-Temperate China: China - Hainan Eastern Asia: Taiwan Asia-Tropical Indian Subcontinent: Bangladesh; India - Andhra Pradesh, - Arunachal Pradesh, - Assam, - Bihar, - Delhi, - Goa, - Gujarat, - Haryana, - Himachal Pradesh, - Jammu and Kashmir, - Karnataka, - Kerala, - Madhya Pradesh, - Maharashtra, - Manipur, - Meghalaya, - Mizoram, - Nagaland, - Orissa, - Pondicherry, - Punjab, - Rajasthan, - Sikkim, - Tamil Nadu, - Tripura, - Uttar Pradesh, - West Bengal; Nepal; Sri Lanka Indo-China: Cambodia; Laos; Myanmar; Thailand; Vietnam Malesia: Indonesia - Celebes, - Java, - Lesser Sunda Islands, - Sumatra; Malaysia; Philippines Papuasia: Papua New Guinea"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 17 Jan 2018]	

Qsn #	Question	Answer
203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	[Elevation range exceeds 1000 m, demonstrating environmental versatility] "C. verrucosa is found in fallow fields and on marshy ground, along rivers and roads, up to 1200 m altitude."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Wagner, W.L. & Herbst, D.R. (1995). Contributions to the flora of Hawaii. IV. New records and name changes. Bishop Museum Occasional Paper 42: 13-27	" <i>Crotalaria verrucosa</i> , quickly distinguished from other species of <i>Crotalaria</i> in the Hawaiian Islands by its blue corolla, was inadvertently omitted by Windler & Skinner (1990) in their treatment of the genus for the Manual. Additional characters that distinguish this species include its striate, 4-angled stem, and the simple, lanceolate, ovate, rhomboid or elliptic leaves. This species is currently known to be naturalized at least on Oahu (D.R. Herbst, field observ., 1995). The Fosberg collection cited below is the earliest record indicating that the species was naturalized in the Hawaiian Islands. Several of these specimens were identified by R. Barneby. Material examined. Oahu: West slope of Ulupau Head along abandoned road in thick <i>Leucaena</i> scrub, fairly common, 10 Dec 1978, Fosberg & Evans 58853 (BISH); 31 May 1926, A.F. Judd 53 (BISH); University of Hawaii, semi-moist ground, 4 Mar 1931, Inafuku, s.n. (BISH); Molokai: Mapulehu, H.S.P.A. introduction, 21 May 1944, A.J. Mangelsdorf, s.n. (BISH)."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Grasslands, sparse forests; 100–200 m. Guangdong, Hainan, Taiwan [Bangladesh, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam; Australasia, introduced in Africa and the Americas]."
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 17 Jan 2018]	"Native: Asia-Temperate China: China - Hainan Eastern Asia: Taiwan Asia-Tropical Indian Subcontinent: Bangladesh; India - Andhra Pradesh, - Arunachal Pradesh, - Assam, - Bihar, - Delhi, - Goa, - Gujarat, - Haryana, - Himachal Pradesh, - Jammu and Kashmir, - Karnataka, - Kerala, - Madhya Pradesh, - Maharashtra, - Manipur, - Meghalaya, - Mizoram, - Nagaland, - Orissa, - Pondicherry, - Punjab, - Rajasthan, - Sikkim, - Tamil Nadu, - Tripura, - Uttar Pradesh, - West Bengal; Nepal; Sri Lanka Indo-China: Cambodia; Laos; Myanmar; Thailand; Vietnam Malesia: Indonesia - Celebes, - Java, - Lesser Sunda Islands, - Sumatra; Malaysia; Philippines Papuasias: Papua New Guinea"

Qsn #	Question	Answer
205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Crotalaria verrucosa is now quite a common weed throughout the tropics."
	Woodson, R. et al. (1980). Flora of Panama. Part V. Family 83. Leguminosae. Subfamily Papilionoideae (Conclusion). Annals of the Missouri Botanical Garden, 67(3), 523-818	"Crotalaria verrucosa is widespread in the tropics and occurs in Central America, the West Indies and Florida as an introduced plant in disturbed ground at elevations up to 1,150 meters"

301	Naturalized beyond native range	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 17 Jan 2018]	". natzd. elsewhere in tropics"
	Woodson, R. et al. (1980). Flora of Panama. Part V. Family 83. Leguminosae. Subfamily Papilionoideae (Conclusion). Annals of the Missouri Botanical Garden, 67(3), 523-818	"Crotalaria verrucosa is widespread in the tropics and occurs in Central America, the West Indies and Florida as an introduced plant in disturbed ground at elevations up to 1,150 meters"
	Ward, D. B. (2009). Keys to the Flora of Florida—24, <i>Crotalaria</i> (Leguminosae). <i>Phytologia</i> 92(1): 3-14	"Crotalaria verrucosa L. Noted in 1974 as naturalized at Subtropical Research Station, Dade Co. (Avery 1490 - FLAS). Not otherwise known outside of cultivation."
	Wagner, W.L. & Herbst, D.R. (1995). Contributions to the flora of Hawaii. IV. New records and name changes. Bishop Museum Occasional Paper 42: 13-27	"Crotalaria verrucosa, quickly distinguished from other species of <i>Crotalaria</i> in the Hawaiian Islands by its blue corolla, was inadvertently omitted by Windler & Skinner (1990) in their treatment of the genus for the Manual. Additional characters that distinguish this species include its striate, 4-angled stem, and the simple, lanceolate, ovate, rhomboid or elliptic leaves. This species is currently known to be naturalized at least on Oahu (D.R. Herbst, field observ., 1995). The Fosberg collection cited below is the earliest record indicating that the species was naturalized in the Hawaiian Islands. Several of these specimens were identified by R. Barneby. Material examined. Oahu: West slope of Ulupau Head along abandoned road in thick <i>Leucaena</i> scrub, fairly common, 10 Dec 1978, Fosberg & Evans 58853 (BISH); 31 May 1926, A.F. Judd 53 (BISH); University of Hawaii, semi-moist ground, 4 Mar 1931, Inafuku, s.n. (BISH); Molokai: Mapulehu, H.S.P.A. introduction, 21 May 1944, A.J. Mangelsdorf, s.n. (BISH)."

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Cited as a general weed, or an agricultural weed, in a number of references. Impacts to crops unverified, so designated as a weed of uncertain impacts at this time] "Weed of: Orchards & Plantations References: Guyana-W-32, Global-N-85, United States of America-W-179, China- W-431, Global-W-344, Pacific-W-621, United States of America-N-301, United States of America-N-839, India-A-948, United States of America-N-101, Global- A-1207, United States of America-N-1292, south and southeast Asia-A-1320, India-A- 1359, south and southeast Asia-A-1408, Cuba-N-1505, French Polynesia-N-1514, India-A-87, Polynesia, West-A-87, Trinidad-A-87, India-W-1672, India-A- 1696, Eastern Caribbean-N-1742, Puerto Rico and the Virgin Islands-AI-1821, India- I-1914, Cuba-NI-2055, United States of America-N-2092, Anguilla-W-1977, Australia-W-1977, Cuba-W-1977, Guyana- W-1977, Niue-W-1977, Papua New Guinea-W-1977, Samoa-W-1977, Suriname-W-1977."

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Herbal, Ornamental Dispersed by: Humans Weed of: Orchards & Plantations" [Reported as an agricultural weed in a number of references. Economic importance unknown]
	Gaddeyya, G., & Kumar, P. R. (2014). Studies on weed infestation of some agricultural fields at Visakhapatnam district, Andhra Pradesh. Journal of Crop and Weed, 10(2), 419-429	"Table 3: The list of weed flora and their status in agricultural crops of study area" [Crotalaria verrucosa - Weed status = Common; impacts unspecified]
	Moody, K. 1989. Weeds Reported in Rice in South and Southeast Asia. International Rice Research Institute, Manila, Philippines	Reported as a weed in rice crops from a number of countries. Impacts unspecified

304	Environmental weed	n
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"C. verrucosa is found in fallow fields and on marshy ground, along rivers and roads, up to 1200 m altitude." [Disturbance adapted weed]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations"

305	Congeneric weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Fonseca, R. L., Guimarães Jr, P. R., Morbiolo, S. R., Scachetti Pereira, R., & Peterson, A. T. (2006). Predicting invasive potential of smooth crotalaria (<i>Crotalaria pallida</i>) in Brazilian national parks based on African records. <i>Weed science</i> , 54(3), 458-463	"Smooth crotalaria is a perennial shrub native to the paleotropics, most likely Africa. This species has invaded several regions around the world (Polhill 1982) and is now considered to rank among the worst weeds, occurring in pastures, roadsides, old fields, and forest edges (Lorenzi 2000). The plant has been recorded in some federal nature reserves in Brazil (Vieira and Pessoa 2001). Although no studies have focused on its effects on natural systems, smooth crotalaria and related species may affect the ecology of invaded areas in several ways: attracting ants to its extrafloral nectaries (Guimaraes et al. 2006), intoxicating animals (Diaz et al. 2003), hosting fungi (USDA 2004), enhancing the nitrogen levels in soil (Ohdan and Daimon 1998), allelopathy (Ohdan et al. 1995), and changing nematode communities (Wang et al. 2004)."
	USDA NRCS. 1999. Sunn Hemp: A Cover Crop for Southern and Tropical Farming Systems. Soil Quality Agronomy Technical Note No.10. Soil Quality Institute, Auburn, AL	"Sunn hemp (<i>Crotalaria juncea</i> L.) is the fastest growing and most important species of the <i>Crotalaria</i> genus. All <i>Crotalaria</i> are good at producing biomass and fixing nitrogen. They are resistant to nematodes, and can grow on droughty soil with low fertility. However, some species, like Showy <i>Crotalaria</i> , (<i>Crotalaria spectabilis</i> L.) are considered noxious weeds because their soybean size causes difficulty in separating the seeds from soybean at cleaning. Also, many species of <i>Crotalaria</i> contain toxic alkaloids in the seeds. In earlier strains of sunn hemp, trichodesmine was identified as the principal toxic alkaloid. Studies have shown poisoning from these earlier strains can occur in both horses and pigs. Showy <i>Crotalaria</i> has been shown to be poisonous to most livestock."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. <i>Flora of China</i> . Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Herbs, erect, 50–100 cm tall. Branches 4-angled, glabrescent. Stipules leaflike, ovate-falcate, 5–8 mm. Leaves simple; petiole 3–5 mm; leaf blade ovate to elliptic, 10–15 × 3–5 cm, thinly membranous, abaxially densely pubescent, adaxially glabrous, base broadly cuneate, apex acuminate. Racemes terminal, 10–20-flowered; bracts linear, ca. 1 mm. Pedicel 3–4 mm; bracteoles inserted apically from middle of pedicel. Calyx subcampanulate, 8–10 mm, 5-lobed; lobes lanceolate, slightly longer than tube. Corolla pale yellow, white, or often tinged blue; standard orbicular to obovate, 1–1.8 cm, base with 2 appendages; wings oblong, 1–1.6 cm; keel ± as long as wings, exerted beyond calyx, rounded with an incurved, fairly shortly twisted beak. Ovary subsessile, pilose on apical part. Legume oblong, 2–4 cm, 10–12-seeded, pubescent. Seeds nearly smooth to papillose, shiny."

402	Allelopathic	
	Source(s)	Notes

Qsn #	Question	Answer
	Skinner, E.R.M. 2006. Allelopathic effects of the cover crop <i>Crotalaria juncea</i> on weed and crop seedling germination and growth. MSc Thesis. University of Georgia, Athens, GA	[No evidence, but other species demonstrate allelopathy in greenhouse trials] "Sunnhemp (<i>Crotalaria juncea</i> L.) is used as a cover crop, but there is little information on its weed suppressive ability. The objective was to determine whether sunnhemp has allelochemical activity to reduce seed germination and seedling growth in weeds, vegetable crops and cover crops. Germination studies were conducted using sunnhemp residues or tissue extracts. The results suggested the possible presence of allelochemicals in the sunnhemp leaves. In the greenhouse, seed germination and seedling growth of the carrot (<i>Daucus carota</i> L.), lettuce (<i>Lactuca sativa</i> L.), and smooth pigweed (<i>Amaranthus hybridus</i> L.), were reduced when grown in soil containing sunnhemp residues. The allelopathic activity was higher in the leaves than in roots or stems. Seeds of various vegetable and cover crops showed inhibited germination when incubated in dishes containing sunnhemp leaf extract, although cereal rye (<i>Secale cereale</i> L.) and wheat (<i>Triticum aestivum</i> L.) were unaffected by the sunnhemp leaf extract."

403	Parasitic	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Herbs, erect, 50–100 cm tall." [Fabaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Nellis, D.W. 1997. Poisonous plants and animals of Florida and the Caribbean. Pineapple Press Inc., Sarasota, FL	"Livestock eat all stages of the plant and show symptoms as described for the other <i>Crotalaria</i> ."

405	Toxic to animals	y
	Source(s)	Notes
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"This species of <i>crotalaria</i> constitutes a potential danger to livestock in open pastures as the plants are eaten from the seedling stage through maturity. Livestock should be kept from infested areas."
	Nellis, D.W. 1997. Poisonous plants and animals of Florida and the Caribbean. Pineapple Press Inc., Sarasota, FL	"Toxic properties The primary toxin in the seeds is the alkaloid <i>crotalaburnine</i> (also called <i>anacrotine</i>). Also present is <i>crotaverrine</i> and other related alkaloids." "Livestock eat all stages of the plant and show symptoms as described for the other <i>Crotalaria</i> ." ... "Folk medicinal use of this plant should be avoided and livestock should be prevented from consuming it. There is no known treatment for the toxic effects of this plant."

406	Host for recognized pests and pathogens	y
	Source(s)	Notes

Qsn #	Question	Answer
	Slaminko, T. L., Miles, M. R., Marios, J. J., Wright, D. L., & Hartman, G. L. (2008). Hosts of <i>Phakopsora pachyrhizi</i> identified in field evaluations in Florida. <i>Plant Health Progress</i> doi:10.1094/PHP-2008-1103-01-RS	[" <i>Phakopsora pachyrhizi</i> , the causal organism of soybean rust, was first found on <i>Glycine max</i> in the continental United States in 2004, and subsequently on <i>Pueraria lobata</i> , <i>Desmodium tortuosum</i> , three <i>Phaseolus</i> species, and <i>Erythrina herbacea</i> in the field. The pathogen has been reported to occur on over 150 legume species worldwide, and it is likely to infect native and introduced legume species in the USA. The objective of this study was to determine if USA native or -naturalized legume species could become infected with <i>P. pachyrhizi</i> in field conditions. A total of 80 accessions representing 52 species in 29 genera were infected in the field trials. <i>Crotalaria retusa</i> , <i>Lathyrus latifolius</i> , <i>Phaseolus angustissimus</i> , <i>P. polystachios</i> , and <i>Robinia hispida</i> are new hosts. This is the first report showing the broad host range of <i>P. pachyrhizi</i> based on field infections in the USA. Some of these hosts grow in the southern USA, and could, like kudzu, overwinter <i>P. pachyrhizi</i> ." ... "Table 1. Legume host species and accessions that were infected with <i>Phakopsora pachyrhizi</i> in a field location at Quincy, FL, and the seed source and sporulation information for each species." [<i>Crotalaria verrucosa</i> among the hosts]

407	Causes allergies or is otherwise toxic to humans	y
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"Seed caused liver damage to test animals."
	CSIRO. 2010. Australian Tropical Rainforest Plants Edition 6 - <i>Crotalaria verrucosa</i> . http://keys.trin.org.au/key-server/data/0e0f0504-0103-430d-8004-060d07080d04/media/Html/index.html . [Accessed 17 Jan 2018]	"This plant is poisonous."
	Nellis, D.W. 1997. Poisonous plants and animals of Florida and the Caribbean. Pineapple Press Inc., Sarasota, FL	"Treatment Folk medicinal use of this plant should be avoided and livestock should be prevented from consuming it. There is no known treatment for the toxic effects of this plant." ... "Said to be cultivated in the tropics as green manure crop (e.g. Taiwan), the wide distribution being based mainly on escapees from experimental cultivations in various countries, used in folk medicine of various countries."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	" <i>C. verrucosa</i> is found in fallow fields and on marshy ground, along rivers and roads, up to 1200 m altitude." [No evidence]
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Grasslands, sparse forests"
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"They grow in open pastures and along roadsides and ditchbanks." [No evidence from habitat]

Qsn #	Question	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Wunderlin, R. P., B. F. Hansen, A. R. Franck, and F. B. Essig. 2018. Atlas of Florida Plants. http://florida.plantatlas.usf.edu/ . [Accessed 18 Jan 2018]	"Crotalaria verrucosa ... Habitat: Full sun, sandy soil."
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"The plants thrive best in full sun though they are shade tolerant. They grow in open pastures and along roadsides and ditchbanks."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	
	Source(s)	Notes
	Useful Tropical Plants Database. 2018. <i>Crotalaria verrucosa</i> . http://tropical.theferns.info/viewtropical.php?id=Crotalaria+verrucosa . [Accessed 18 Jan 2018]	"Plants in this genus generally prefer a sunny position, succeeding in dry to moist, well-drained soils"
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"This species tolerates a hard compact soil that is not well drained, and is often found in rocky soils."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Herbs, erect, 50–100 cm tall."

412	Forms dense thickets	n
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"C . verrucosa is found in fallow fields and on marshy ground, along rivers and roads, up to 1200 m altitude."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Grasslands, sparse forests"
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"They grow in open pastures and along roadsides and ditchbanks." ... Chemical control with selective herbicides is recommended where stands are abundant." [Unknown if stands exclude other vegetation]

501	Aquatic	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Terrestrial] "Herbs, erect, 50–100 cm tall." ... "Grasslands, sparse forests; 100–200 m."

502	Grass	n
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Qsn #	Question	Answer
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 17 Jan 2018]	Family: Fabaceae (alt.Leguminosae) Subfamily: Faboideae Tribe: Crotalarieae
503	Nitrogen fixing woody plant	y
	Source(s)	Notes
	Okonwu, K., & Eboh, I. G. (2017). Effects of Seed treatment on the germination of <i>Crotalaria verrucosa</i> L. <i>Journal of Applied Life Sciences International</i> , 10(2): 1-8	" <i>C. verrucosa</i> is a perennial shrub growing to about 50–100 cm in height." ... " <i>Crotalaria verrucosa</i> is a potential ornamental and is sometimes grown as green manure, forming a symbiotic relationship with certain soil bacteria which form nodules on the root and fix nitrogen."
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"Annual, subwoody herb, 0.5-1 m tall, with many quadrangular, velvety hairy, yellow branches." [Not a geophyte]
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"Distribution Originating from tropical Asia, now pantropically distributed." [No evidence. Broad native & introduced ranges]
602	Produces viable seed	y
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. <i>Flora of China</i> . Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Legume oblong, 2–4 cm, 10–12-seeded, pubescent. Seeds nearly smooth to papillose, shiny."
	Useful Tropical Plants Database. 2018. <i>Crotalaria verrucosa</i> . http://tropical.theferns.info/viewtropical.php?id=Crotalaria+verrucosa . [Accessed 17 Jan 2018]	"Propagation Seed"
603	Hybridizes naturally	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown. No evidence found
604	Self-compatible or apomictic	y

Qsn #	Question	Answer
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"It fixes nitrogen and is self-pollinating."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Raju, A. S., & Rao, S. P. (2006). Nesting habits, floral resources and foraging ecology of large carpenter bees (<i>Xylocopa latipes</i> and <i>Xylocopa pubescens</i>) in India. <i>Current Science</i> , 90(9): 1210-1217	"Both female and male bees of these two species collect nectar from several plant species belonging to different families (polylecty). The nectar plants reported include <i>Alangium salviifolium</i> , <i>Calotropis gigantea</i> , <i>C. procera</i> , <i>Tecoma stans</i> , <i>Bauhinia purpurea</i> , <i>B. racemosa</i> , <i>B. variegata</i> , <i>Crotalaria laburnifolia</i> , <i>C. verrucosa</i> , <i>Gliricidium sepium</i> , <i>Pongamia pinnata</i> , <i>Tephrosia purpurea</i> , <i>Anisomeles indica</i> , <i>A. malabarica</i> , <i>Careya arborea</i> , <i>Moringa oleifera</i> , <i>Antigonon leptopus</i> , <i>Gmelina arborea</i> , <i>G. asiatica</i> and <i>Tribulus terrestris</i> " ... "Figure 1. Nectar flowers of <i>Xylocopa</i> bees: a, <i>X. latipes</i> on <i>Crotalaria laburnifolia</i> ; b, <i>X. latipes</i> on <i>Crotalaria verrucosa</i> ; c, <i>X. pubescens</i> on <i>C. verrucosa</i> ; d, <i>X. pubescens</i> on <i>Peltophorum pterocarpum</i> ."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Useful Tropical Plants Database. 2018. <i>Crotalaria verrucosa</i> . http://tropical.theferns.info/viewtropical.php?id=Crotalaria+verrucosa . [Accessed 18 Jan 2018]	"Propagation Seed" [No evidence]
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"This annual weed is 1 to 4 feet high and has angled, zigzag branches, which are sparsely covered with fine hairs. The simple leaves are borne alternately along the stem on short leaf stems; they are rounded at the apex and narrowed at the base." [Annual growth habit. Sometime perennial, but no evidence of vegetative spread]

607	Minimum generative time (years)	1
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"Annual, subwoody herb, 0.5-1 m tall, with many quadrangular, velvety hairy, yellow branches."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Parthasarathy, N., Arul Pragasan, L. & Muthumperumal, C. 2012. Invasive Alien Plants in Tropical Forests of the South-eastern Ghats, India: Ecology and Management. Pp. 162-173 in J.R. Bhatt, J.S. Singh, R.S. Tripathi, S.P. Singh and R.K. Kohli (eds.). <i>Invasive Alien Plants : An Ecological Appraisal for the Indian Subcontinent</i> . CABI, Wallingford, UK	"Appendix 13.2. ... <i>Crotalaria verrucosa</i> ... Dispersal Mode = autochorous" [Autochorous plants disperse their seed without any help from an external vector, as a result this limits plants considerably as to the distance they can disperse their seed]

Qsn #	Question	Answer
	Okonwu, K., & Eboh, I. G. (2017). Effects of Seed treatment on the germination of <i>Crotalaria verrucosa</i> L. Journal of Applied Life Sciences International, 10(2): 1-8	" <i>Crotalaria verrucosa</i> grows on fallow fields, on marshy grounds, along rivers and roads, grassland and sparse forests; at elevations up to 1200 m." [Presence along roads suggest adaptations to disturbance & potential for inadvertent dispersal along heavily trafficked corridors, but seeds otherwise lack means of external attachment]

702	Propagules dispersed intentionally by people	n
	Source(s)	Notes
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, Volume 2. Springer-Verlag, Berlin, Heidelberg, New York	"Said to be cultivated in the tropics as green manure crop (e.g. Taiwan), the wide distribution being based mainly on escapees from experimental cultivations in various countries, used in folk medicine of various countries." [No current evidence of intentional dispersal or introduction into the Hawaiian Islands]

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations" [No evidence, but potential for crop contamination exists]
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	[Potentially yes if occurring as a crop weed] "They grow in open pastures and along roadsides and ditchbanks. Apparently the seeds remain viable for long periods, as plants may be found in freshly plowed fields or pastures."

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Parthasarathy, N., Arul Pragasan, L. & Muthumperumal, C. 2012. Invasive Alien Plants in Tropical Forests of the South-eastern Ghats, India: Ecology and Management. Pp. 162-173 in J.R. Bhatt, J.S. Singh, R.S. Tripathi, S.P. Singh and R.K. Kohli (eds.). Invasive Alien Plants : An Ecological Appraisal for the Indian Subcontinent. CABI, Wallingford, UK	"Appendix 13.2. ... <i>Crotalaria verrucosa</i> ... Dispersal Mode = autochorous" [Autochorous plants disperse their seed without any help from an external vector, as a result this limits plants considerably as to the distance they can disperse their seed]
	Subramaniam, S., Pandey, A. K. & Rather, S. A. 2015. Systematic and adaptive significance of seed morphology in <i>Crotalaria</i> L. (Fabaceae). The International Journal of Plant Reproductive Biology 7(2): 135-146	"Flat and compressed seeds get effectively dispersed." ... "The seeds of <i>Crotalaria</i> species are generally reniform, compressed, flat and asymmetric. The flat and compressed seeds on their release from the pods float in air and get drifted and dispersed." [Generic description. Unknown if <i>Crotalaria verrucosa</i> seeds are aided by wind in dispersal, but seeds themselves do not possess any apparent adaptations for wind dispersal]
	Woodson, R. et al. (1980). Flora of Panama. Part V. Family 83. Leguminosae. Subfamily Papilionoideae (Conclusion). Annals of the Missouri Botanical Garden, 67(3), 523-818	"Legume inflated, 2.4-3.0 cm long, strigulose; seeds ca. 11, tan to brown, oblique cordiform, to 4.5 mm long."

705	Propagules water dispersed	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Hanum, I.F. & Van der Maesen, L.J.G. (eds.). 1997. PROSEA : Plant Resources of South-East Asia 11, Auxiliary Plants. Prosea Foundation, Bogor, Indonesia	"C . verrucosa is found in fallow fields and on marshy ground, along rivers and roads, up to 1200 m altitude." [Distribution along river suggests potential movement by water]
	Okonwu, K., & Eboh, I. G. (2017). Effects of Seed treatment on the germination of <i>Crotalaria verrucosa</i> L. Journal of Applied Life Sciences International, 10(2): 1-8	" <i>Crotalaria verrucosa</i> grows on fallow fields, on marshy grounds, along rivers and roads, grassland and sparse forests; at elevations up to 1200 m." [Presence along rivers suggest potential movement by water]
	Subramaniam, S., Pandey, A. K. & Rather, S. A. 2015. Systematic and adaptive significance of seed morphology in <i>Crotalaria</i> L. (Fabaceae). The International Journal of Plant Reproductive Biology 7(2): 135-146	"Flat and compressed seeds get effectively dispersed." ... "The seeds of <i>Crotalaria</i> species are generally reniform, compressed, flat and asymmetric. The flat and compressed seeds on their release from the pods float in air and get drifted and dispersed." [Ability to float on air would likely allow seeds to float on water]

706	Propagules bird dispersed	n
	Source(s)	Notes
	Parthasarathy, N., Arul Pragasan, L. & Muthumperumal, C. 2012. Invasive Alien Plants in Tropical Forests of the South-eastern Ghats, India: Ecology and Management. Pp. 162-173 in J.R. Bhatt, J.S. Singh, R.S. Tripathi, S.P. Singh and R.K. Kohli (eds.). Invasive Alien Plants : An Ecological Appraisal for the Indian Subcontinent. CABI, Wallingford, UK	"Appendix 13.2. ... <i>Crotalaria verrucosa</i> ... Dispersal Mode = autochorous" [Autochorous plants disperse their seed without any help from an external vector, as a result this limits plants considerably as to the distance they can disperse their seed]

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Parthasarathy, N., Arul Pragasan, L. & Muthumperumal, C. 2012. Invasive Alien Plants in Tropical Forests of the South-eastern Ghats, India: Ecology and Management. Pp. 162-173 in J.R. Bhatt, J.S. Singh, R.S. Tripathi, S.P. Singh and R.K. Kohli (eds.). Invasive Alien Plants : An Ecological Appraisal for the Indian Subcontinent. CABI, Wallingford, UK	"Appendix 13.2. ... <i>Crotalaria verrucosa</i> ... Dispersal Mode = autochorous" [Autochorous plants disperse their seed without any help from an external vector, as a result this limits plants considerably as to the distance they can disperse their seed]

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Nellis, D.W. 1997. Poisonous plants and animals of Florida and the Caribbean. Pineapple Press Inc., Sarasota, FL	"Livestock eat all stages of the plant and show symptoms as described for the other <i>Crotalaria</i> ." [Unknown if seeds are consumed by livestock or if they survive gut passage]

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"Because of their copious production of highly viable seeds capable of prolonged dormancy, the plants require constantly recurring control measures." [Densities unknown]

Qsn #	Question	Answer
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Legume oblong, 2–4 cm, 10–12-seeded, pubescent. Seeds nearly smooth to papillose, shiny" [Seed densities unknown]

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"Apparently the seeds remain viable for long periods, as plants may be found in freshly plowed fields or pastures."
	Okonwu, K., & Eboh, I. G. (2017). Effects of Seed treatment on the germination of <i>Crotalaria verrucosa</i> L. Journal of Applied Life Sciences International, 10(2): 1-8	"The study has shown that <i>C. verrucosa</i> exhibits physical or exogenous dormancy which is imposed to a large extent by the seed coat and germination was enhanced by the wear out action of the acid on the seed coat. The avoidance of germination is ecologically advantageous to the plant especially when it grows in harsh climatic conditions. However, this is undesirable when quick and consistent seed germination is required for successful establishment of this economically important plant species. The results demonstrate that this aim can be achieved with chemical scarification of the seeds of <i>C. verrucosa</i> using 100% H2SO4 for 20 minutes."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"Chemical control with selective herbicides is recommended where stands are abundant. Ester forms of both 2,4--D and 2,4,5-T are effective."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	Notes
	Oakes, A.J. & Butcher, J.O. 1962. Poisonous and injurious plants of the U.S. Virgin Islands.	"Manual control is practical for sparse stands." ... "Young, small plants are easily killed by ordinary cultivation practices."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Thrives in tropical climates
- Widely naturalized, including Oahu, & possibly Molokai (Hawaiian Islands)
- Weedy plant, potential crop weed
- Other species have become invasive
- Toxic to animals & people
- Host of soybean rust pathogen
- Shade tolerant
- Semi-woody N-fixing plant can modify soil nutrients
- Reproduces by seed
- Self-pollinating
- Able to reach maturity in one growing season
- Seeds lack a dispersal mechanism, but are likely moved by water when grown in riparian areas
- Forms a persistent seed bank

Low Risk Traits

- Unarmed (no spines, thorns, or burrs)
- Palatable despite reports of toxicity
- Not reported to spread vegetatively
- Herbicides may provide effective control
- Mechanical control effective in low densities & for young plants