

Key Words: Evaluate, Naturalized, Herbaceous Annual, Cover Crop, Self-compatible

**Family:** *Fabaceae*

**Taxon:** *Crotalaria juncea*

**Synonym:** *Crotalaria benghalensis* Lam.  
*Crotalaria fenestrata* Sims  
*Crotalaria porrecta* Wall.  
*Crotalaria sericea* Willd.  
*Crotalaria tenuifolia* Roxb.  
*Crotalaria viminea* Wall.

**Common Name:** Indian hemp  
 Madras hemp  
 sann hemp  
 sunn crotalaria

<b>Questionnaire :</b>	current 20090513	<b>Assessor:</b>	Chuck Chimera	<b>Designation:</b> EVALUATE
<b>Status:</b>	Assessor Approved	<b>Data Entry Person:</b>	Chuck Chimera	<b>WRA Score 1</b>
101	Is the species highly domesticated?		y=-3, n=0	n
102	Has the species become naturalized where grown?		y=1, n=-1	
103	Does the species have weedy races?		y=1, n=-1	
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)	Intermediate
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)	
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)	n
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	
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	
406	Host for recognized pests and pathogens		y=1, n=0	n
407	Causes allergies or is otherwise toxic to humans		y=1, n=0	
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	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	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	n
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)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
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	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides	y=-1, n=1	
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: EVALUATE

WRA Score 1

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**Supporting Data:**

101	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Is the species highly domesticated? No] "Because sun-hemp has been cultivated since antiquity its origins are not known ..." [Although widely cultivated there is no evidence that the cultivated plants are ecologically different from the wild ones. Self compatible <i>Crotalaria</i> are being developed for breeding pure lines, however self compatibility does occur naturally in the species too].
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Species suited to tropical or subtropical climate(s) 2-High] "ASIA-TROPICAL Indian Subcontinent: Bangladesh; Bhutan; 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"
202	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Quality of climate match data 1-Intermediate] "Because sun hemp has been cultivated since antiquity its origins are unknown, but India has been hypothesized as its native homeland."
202	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Quality of climate match data 1-Intermediate] "exact native range in s. Asia obscure"
203	2005. Cook, B.G./Pengelly, B.C./Brown, S.D.et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Broad climate suitability (environmental versatility)? Yes] "C. juncea is grown in India from 17 - 30° N, in areas with 24-hour average annual temperature (AAT24) of 15 - 27.5° C, in Brazil, from the equatorial conditions of the Amazon belt to 22.5° S in the State of São Paulo (AAT24 18 - 27° C), and in Nepal to about 1300 m ASL (e.g. Kathmandu 27° 42' N, 1,300 m ASL, AAT24 18.6° C). Elsewhere, it is grown in areas with AAT24 as low as 8.4° C, providing there is a frost-free growing period of 2 - 3 months. Although it can tolerate light frosts, with -2° C the minimum tolerated without injury, growth and nitrogen fixation are reduced under cool conditions."
203	2010. Wu, Z.Y./Raven, P.H./Hong, D.Y. ( eds.). Flora of China. Vol. 10 (Fabaceae). Science Press Beijing, and Missouri Botanical Garden Press, St. Louis.,	[Broad climate suitability (environmental versatility)? Yes] "Sparse forests, along trails; below 100–2000 m." [Elevation range exceeds 1000 m, demonstrating environmental versatility]
203	2012. Tropicos.org. Tropicos [Online Database]. Missouri Botanical Garden, <a href="http://www.tropicos.org/">http://www.tropicos.org/</a>	[Broad climate suitability (environmental versatility)? Yes] [Specimens collected from established populations in Colombia above 1000 m (1330 and 1560 m)]
204	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Native or naturalized in regions with tropical or subtropical climates? Yes] "ASIA-TROPICAL Indian Subcontinent: Bangladesh; Bhutan; 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"
205	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Does the species have a history of repeated introductions outside its natural range? Yes] "cultivated throughout tropics"

301	1997. Wagner, W.L./Shannon, R.K./Herbst, D.R.. Contributions to the Flora of the Hawai'i. VI. Bishop Museum Occasional Papers. 48: 51-65.	[Naturalized beyond native range? Yes] "This species has not previously been reported as naturalized in the Hawaiian Islands, but it has been cultivated (Neal, 1965). It can be distinguished from the other naturalized Hawaiian species of the genus by the following characters adopted from the treatment by Rudd (1991). It is an annual herb up to 2.5 m tall; stems erect, ribbed, subappressed pubescent; leaves simple, oblong to oblanceolate, apex acute to obtuse, stipules filiform, ca. 2 mm long; flowers 15–20 mm long, in terminal inflorescences 10–25 cm long, bracts narrowly lanceolate, 3–5 mm long, calyx 15–20 mm long, weakly bilabiate, the lobes 3–4 times as long as the tube, velutinous; petals 15–25 mm long, bright yellow, with dark red or brown streaks, the standard to 25 mm long, the keel to 20 mm long, with a twisted beak, the wings shorter than the keel; pods cylindrical, 2.5–3.5(–5.5) cm long, velutinous, sessile; seeds 6–15 per pod, cordiform, 4–6 mm long, light brown to black. <i>Crotalaria juncea</i> is native to India, but is widely cultivated as a cover crop and for fiber. In the Hawaiian Islands it was cultivated by the Hawaiian Sugar Planters' Association as early as 1918 (Rock s.n., BISH) and is apparently known as sunhemp and grown for its nitrogen fixation properties (L. Stemmermann, pers. comm.). It has become widely naturalized and now has a pantropical distribution. Material examined. O'AHU: Honolulu, Kalakaua Ave., 9 Sept. 1962, Sasakawa s.n. (BISH); det. by R. Barneby. HAWAI'I: Ka'u Dist., along Ka'alu'alu-Wai'ohinu rd., cleared field in subdivision, 230 m, 19 June 1990, Wagner et al. 6392 (US); det. by D. Windler."
301	2010. Wu, Z.Y./Raven, P.H./Hong, D.Y. ( eds.). Flora of China. Vol. 10 (Fabaceae). Science Press Beijing, and Missouri Botanical Garden Press, St. Louis.,	[Naturalized beyond native range? Yes] "Cultivated or naturalized in Fujian, Guangdong, Guangxi, Jiangsu, Shaanxi, Shandong Sichuan, Taiwan, Yunnan, and Zhejiang [Bhutan, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Thailand, Vietnam]. <i>Crotalaria juncea</i> is cultivated as a fiber crop ("Sunn Hemp") and as a green manure. It is widely naturalized in Africa, tropical and sub-tropical America, Asia, Australia, and Papua New Guinea. Its original distribution is probably S Asia."
301	2012. Wagner, W.L./Herbst, D.R./Khan, N./Flynn, T.. Hawaiian Vascular Plant Updates: A Supplement to the Manual of the Flowering Plants of Hawai'i & Hawai'i's Ferns & Fern Allies. <a href="http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/supplement.htm">http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/supplement.htm</a>	[Naturalized beyond native range? Yes] "newly naturalized (O'ahu, Hawai'i); new island (East Maui)"
302	2007. Randall, R.P.. Global Compendium of Weeds - <i>Crotalaria juncea</i> . <a href="http://www.hear.org/gcw/species/crotalaria_juncea/">http://www.hear.org/gcw/species/crotalaria_juncea/</a>	[Garden/amenity/disturbance weed? Potentially] Listed as naturalized and/or a weed in many references, but evidence of negative impacts was not found or unspecified.
302	2011. Zenni, R.D./Ziller, S.R.. An overview of invasive plants in Brazil. <i>Revista Brasileira de Botânica</i> . 34(3): 431-446.	[Garden/amenity/disturbance weed? Potentially. Listed as an invasive plant, but there are no descriptions of impacts or control efforts] "Table 1. Invasive alien plants records for the physiognomic-ecological classes (UNESCO 1973) and ecoregion (Olson et al. 2001) in Brazil. Data is from the I3N Brazil database at <a href="http://www.institutohorus.org.br">www.institutohorus.org.br</a> . We gathered location references in the database from field observations, interviews and literature reviews from 2003 until 2008. Locations are mostly related to municipalities or geographical reference points. Phytophysiognomies with no correspondence in the original physiognomic-ecological classes are marked with *."
303	2007. Randall, R.P.. Global Compendium of Weeds - <i>Crotalaria juncea</i> . <a href="http://www.hear.org/gcw/species/crotalaria_juncea/">http://www.hear.org/gcw/species/crotalaria_juncea/</a>	[Agricultural/forestry/horticultural weed? No evidence]
304	2007. Randall, R.P.. Global Compendium of Weeds - <i>Crotalaria juncea</i> . <a href="http://www.hear.org/gcw/species/crotalaria_juncea/">http://www.hear.org/gcw/species/crotalaria_juncea/</a>	[Environmental weed? No] Listed as an environmental weed, but no evidence of environmental impacts were found.
305	1999. USDA NRCS. Sunn Hemp: A Cover Crop for Southern and Tropical Farming Systems. Soil Quality Agronomy Technical Note No.10. Soil Quality Institute, Auburn, AL	[Congeneric weed? Yes] "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."

305	2006. Fonseca, R.L./Guimarães Jr., P.R./Morbiolo, S.R./Scachetti-Pereira, R./Peterson, A.T.. 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.	[Congeneric weed? Yes] "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)."
401	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Produces spines, thorns or burrs? No] " <i>Crotalaria juncea</i> is an erect, herbaceous, laxly branched annual, 1-3.5 m tall. The stems are cylindrical and ribbed, pubescent, up to 2 cm in diameter; vegetative parts covered with short, downy hairs. Long, strong taproot, well developed lateral roots, and multibranched and lobed nodules, up to 2.5 cm in length. Leaves simple with minute, pointed stipules; petiole entire, short, about 5 mm long with pulvinus blade, linear elliptic to oblong, 4-12 x 0.5-3, bright green."
402	2006. Skinner, E.R.M.. 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	[Allelopathic? Potentially. Demonstrated 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."
402	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Allelopathic? No evidence] "Nitrogen fixing: <i>C. juncea</i> is capable of fixing atmospheric nitrogen. Soil improver: <i>C. juncea</i> is widely grown in the tropics as a green manure. Total green matter yield averages 18 27 t/ha; forage yield, 5-19 t/ha. As well as producing high organic-matter yields, it can reduce the build-up of root-knot nematode populations. Intercropping: Often grown as a cover crop and in rotation with tobacco, vegetables, dry grains, rice, corn, cotton, sugarcane, pineapples, coffee, and orchard crops."
403	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), <i>Progress in new crops</i> . ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Parasitic? No. Fabaceae] "Sunn hemp is a short-day, erect shrubby annual, generally 1 to 4 m in height. The stems are cylindrical and ribbed. Branching in the upper portion is minimized with dense plantings. The simple, elliptic to oblong shaped leaves, are spirally arranged on the stem. The root system is characterized by a long, strong taproot, well developed lateral roots, and much branched and lobed nodules, up to 2.5 cm in length."
404	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), <i>Progress in new crops</i> . ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Unpalatable to grazing animals? No] "Most of the present-day sun hemp production is located in India, Bangladesh, and Brazil, where it is grown as a green manure crop, a fodder crop, or for the bast fibers."
404	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. <i>Tropical Forages: an interactive selection tool</i> , [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Unpalatable to grazing animals? No] "While finding some application as a forage, it is primarily grown for production of bast fibres used in the manufacture of twine and cord, high quality paper and pulp; also used as a green manure or cover crop and as a break crop to reduce weed and nematode populations." ... "When fresh, it is not readily eaten by ruminants, but is well accepted once dry."
405	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), <i>Progress in new crops</i> . ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Toxic to animals? Potentially Yes] "Many species of <i>Crotalaria</i> contain toxic pyrrolizidine alkaloids in the seeds. In <i>C. juncea</i> , trichodesmine was identified as the principal toxic alkaloid (Zhang 1985). Studies have indicated that poisoning can occur in both horses (Nobre et al. 1994) and pigs (Zhang 1985) when <i>C. juncea</i> seed are ingested."

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- 405 2005. Cook, B.G./Pengelly, B.C./Brown, S.D.et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <http://www.tropicalforages.info/index.htm> [Toxic to animals. Potentially, although 'Tropics Sun' apparently non-toxic] "As with many other members of the genus, *C. juncea* contains pyrrolizidine alkaloids, which are converted into potent toxins in the liver. Highest alkaloid levels are found in the seeds. Toxicity varies from toxic to non-toxic among genotypes. Laboratory tests and feeding trials with the Hawaiian variety, 'Tropics Sun', suggest that both seeds and forage of are nontoxic. Stress conditions may also affect the degree of toxicity. To reduce chances of poisoning, it is best to limit *C. juncea* forage intake to no more than 45% in rations for sheep, 10% for cattle, and not fed at all to horses and pigs."
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- 405 2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, (<http://www.worldagroforestry.org/af/treedb/>) [Toxic to animals? Potentially] "Fodder: *C. juncea* is widely used as forage in Sri Lanka and southern Africa. The presence of compounds that cause unpalatability, which are poisonous under some conditions, is typical of the genus *Crotalaria*. Seeds may contain about 35-40% protein; stems are about 40% fibre. Leaves and stems are dried, as animals do not eat *C. juncea* when it is green. Sheep will not suffer any adverse effects if forced to eat dried forage, but they will suffer from toxicity if fed large quantities of seed. *C. juncea* should not be fed to horses, and intake of hay by cattle should be restricted to about 10% of their diet."
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- 405 2010. Massey, J.M.. Evaluation of a New Sunn Hemp (*Crotalaria juncea* L.) Cultivar in Alabama. MSc Thesis. Auburn University, Auburn, Alabama [Toxic to animals? Possible, but certain cultivars non-toxic] "Unlike most congeners (Yost and Evans, 1988; Valenzuela and Smith, 2002), 'Tropic Sun' is deemed non-toxic (USDA, 1999). Reddy et al. (1999) reported sheep (*Ovis aries*) may be fed up to 45% sunn hemp hay without serious illness. Hess and Mosjidis (2008) found broiler (*Gallus domesticus*) performance was reduced with elevated levels of 'Selection PBU' seed in feed (5%), but mortality was unaffected. *Crotalaria* spp. seed toxicity is due to pyrrolizidine alkaloids (Cook and White, 1996) which oxidases in the liver convert to powerful toxins (Mattocks, 1978). Alkaloid contents may vary by sunn hemp maturity at termination and cultivar selection, thus resulting in the conflicting results found among sunn hemp poisoning studies. Sunn hemp seed alkaloids have been attributed to poisoning and decreased performance in pigs (*Sus scrofa domestica*) (Duke, 1981; Zhang, 1985), horses (*Equus caballus*) (Nobre et al., 1994), and other livestock (McKee et al., 1946; Russell et al., 1997) when fed seeds. However others found sunn hemp seed had no alkaloid toxicity as a feed to swine and horses (Purseglove, 1981), or cattle (*Bos taurus*) and sheep (Anonymous, 1921; Timon, 1929). Agricultural Research Services Poisonous Plant Laboratory and the University of Hawaii also determined 'Tropic Sun' seeds were not toxic to livestock (Rotar and Joy, 1983). When grazed, fresh sunn hemp had limited palatability to animals and drying sunn hemp to make hay is suggested to increase palatability (Duke, 1981). 'Tropic Sun' has been deemed palatable to livestock (Rotar and Joy, 1983). Morris and Kays (2005) suggested sunn hemp as a dietary fiber source using a variety low in phytochemicals."
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406	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Host for recognized pests and pathogens? No] "No serious diseases have developed in South Texas and few have been reported for the United States. However, the soils of South Texas are naturally infested with <i>Phymatotrichum</i> root rot, incited by <i>Phymatotrichum omnivorum</i> Duggar [= <i>Phymatotrichopsis omnivora</i> (Duggar) Hennebert], a fungal pathogen that attacks over 2,000 plant species (Streets and Bloss 1973). Sunn hemp is reported to be susceptible to attack from this fungal pathogen (Streets and Bloss 1973; Cook and Hickman 1990). However, laboratory studies have indicated that sunn hemp is more resistant to <i>P. omnivorum</i> than kenaf (Cook and Hickman 1990). Control of this pathogen can be achieved through cultural practices and crop rotations (Streets and Bloss 1973). Other pathogens of sunn hemp that have been reported from the United States are a powdery mildew, caused by <i>Microsphaera diffusa</i> Cook and Peck, and a root and stem rot, incited by <i>Sclerotium rolfsii</i> Sacc. (Farr et al. 1989). Serious diseases of sunn hemp grown in India are anthracnose, caused by <i>Colletotrichum curvatum</i> Briant and Martyn (Mitra 1934; Whiteside 1955) and a wilt, caused by <i>Fusarium udam</i> E.J. Butler f. sp. <i>Crotalariae</i> (G.S. Kulkarni) Subramanian (Mitra 1934; Kundu 1964; Purseglove 1968). Fungicide seed treatments and crop rotations are the most recommended and practiced disease control measures (Mitra 1934; Whiteside 1955). Sources of resistance to anthracnose have been reported by Dey et al. (1990), indicating the potential to reduce disease losses through the development of anthracnose resistant varieties. A fungus ( <i>Ceratocystis fimbriata</i> Ellis & Halst) that causes a wilt disease of sunn hemp in South America has been reported by Barros Salgado et al. (1972) and Malaguti (1951). In addition to implementing crop rotations for disease control, sunn hemp germplasm which possesses resistance to <i>C. fimbriata</i> has been reported (Ribeiro et al. 1977). The major insect pests of sunn hemp in the United States are reported to be the lima bean pod borer, <i>Etiella zinckenella</i> Treit. and bella moth, <i>Utetheisa bella</i> L. (Seale et al. 1957). In Florida, these insect pests were reported to attack the fruiting pods, with little to no seed being produced. In India, the two major insect pests of sunn hemp are the sunn hemp moth ( <i>Utetheisa pulchella</i> L.), which feed on the leaves and seed pods, and the top-shoot borer ( <i>Laspeyresia pseudonectis</i> Meyr.), which bores into the apical tip of the plant, causing excessive branching and cessation of growth (Kundu 1964). Dempsey (1975) reports that significant shoot borer resistance has been identified. Other insect pests that are reported to periodically attack sunn hemp are the leaf feeding caterpillars, <i>Argina cribraria</i> Clerck and <i>A. syringa</i> Cramer. Additional stem or shoot borer species include <i>Laspeyresia tridenta</i> Meyr., <i>Cymotricha tetraschema</i> Meyr., and <i>Selinas monotropa</i> Gaert. Dempsey (1975) and Reddy (1956) also report that the sunn hemp mirid ( <i>Ragnus importunitas</i> Distant), flea beetle ( <i>Longitarsus belgaumensis</i> Jac.), and stink bug ( <i>Nezara viridula</i> L.) will attack sunn hemp. In 1995, the silverleaf whitefly ( <i>Bemisia argentifolii</i> Bellows & Perring) was observed to feed and reproduce on the lower surface of sunn hemp leaves. Although no actual damage was quantified, premature leaf defoliation appeared to occur. " [No evidence that the above are economic pests. <i>Nezara viridula</i> (green stink bugs) is a recognized economic pest but its host range is very wide and compromises a range of fruit trees, vegetables, ornamentals and field crops ]
407	2004. Singh, A.B./Kumar, P.. Aerial Pollen Diversity in India and Their Clinical Significance in Allergic Diseases. <i>Indian Journal of Clinical Biochemistry</i> . 19(2): 190-201.	[Causes allergies or is otherwise toxic to humans? Yes. Pollen is allergenic to susceptible individuals] "Clinical studies undertaken recently by various medical centres under AICP on Aeroallergens and Human Health (4) revealed important allergenic pollen for various regions in India." ... "At Calcutta 28.8% of the patients were sensitive against <i>Solanum sylimbrifolium</i> , while <i>Crotalaria juncea</i> (21.1%) and 18.18% each against <i>Ricinus communis</i> and <i>Ipomea fistulosa</i> ."
408	2008. Logan, N.. Living Fuel Breaks Guide for Leeward Hawaii. Integrated Living Systems Design LLC, <a href="http://www.rnl3.net/ILSDWeb/Projects/ManualLFBv2/Living_Fuelbreaks_manual_v2.htm">http://www.rnl3.net/ILSDWeb/Projects/ManualLFBv2/Living_Fuelbreaks_manual_v2.htm</a>	[Creates a fire hazard in natural ecosystems? No evidence] Being evaluated as a living fuel break to prevent fire spread.
408	2012. WRA Specialist. Personal Communication.	[Creates a fire hazard in natural ecosystems? No evidence] [Probably not - a herbaceous plant, not known to occur in groups or in thickets, except when cultivated as a cover crop.]
409	1977. Pandey, B.N./Sinha, R.P.. Light as a Factor in Growth and Morphogenesis. I. Effect of Artificial Shading on <i>Crotalaria juncea</i> L. and <i>C. sericea</i> Retz.. <i>New Phytologist</i> . 79(2): 431-439.	[Is a shade tolerant plant at some stage of its life cycle? No] "From their overall performance in their normal habitats <i>Crotalaria juncea</i> L. and <i>C. sericea</i> Retz. appear to behave differently in their response to different light climates. While <i>C. juncea</i> grows well only in the high illumination of cropped fields, <i>C. sericea</i> can tolerate some shading under a forest canopy. The luxuriant growth of both species, and especially of <i>C. juncea</i> , during the period June-September when there are long hours of daylight seemed a further point meriting investigation"

409	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Is a shade tolerant plant at some stage of its life cycle? No] "Any reduction in light results in a growth reduction."
410	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Tolerates a wide range of soil conditions? Yes] " <i>Crotalaria juncea</i> is the most important and fastest growing species of the <i>Crotalaria</i> genus. Although generally considered to be a tropical or subtropical crop, it is drought resistant and has a wide range of adaptation to soil types."
410	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Tolerates a wide range of soil conditions? Yes] "Grows on most well-drained soils. For fibre, it is best on fairly light textured soil (sandy loam or loam) of at least moderate fertility, but for other purposes, it will also grow well on clay soils and tolerates low fertility, providing soils are well-drained. While it is adapted to pH from 5 to 8.4, it is best in the near neutral range (pH 6 - 7), that favours phosphate availability. Although <i>C. juncea</i> is mostly listed as having a low tolerance to salt, tolerance of moderate salinity is also claimed."
411	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Climbing or smothering growth habit? No] "Sunn hemp is a short-day, erect shrubby annual, generally 1 to 4 m in height."
412	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Forms dense thickets? No] No evidence
412	2010. Wu, Z.Y./Raven, P.H./Hong, D.Y. ( eds.). Flora of China. Vol. 10 (Fabaceae). Science Press Beijing, and Missouri Botanical Garden Press, St. Louis.,	[Forms dense thickets? No] No evidence
412	2011. Zenni, R.D./Ziller, S.R.. An overview of invasive plants in Brazil. <i>Revista Brasileira de Botânica</i> . 34(3): 431-446.	[Forms dense thickets? No] No evidence
412	2012. Wagner, W.L./Herbst, D.R./Khan, N./Flynn, T.. Hawaiian Vascular Plant Updates: A Supplement to the Manual of the Flowering Plants of Hawai'i & Hawai'i's Ferns & Fern Allies. <a href="http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/supplement.htm">http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/supplement.htm</a>	[Forms dense thickets? No] No evidence
501	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Aquatic? No. Terrestrial] "Sunn hemp is a short-day, erect shrubby annual, generally 1 to 4 m in height."
502	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Grass? No] Fabaceae
503	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Nitrogen fixing woody plant? No] "It produced high organic matter yields, was able to fix nitrogen, and could reduce the build-up of root-knot nematode populations (Breitenbach 1958; Dempsey 1975)." ... "Sunn hemp is a short-day, erect shrubby annual, generally 1 to 4 m in height." [Nitrogen fixing, but non-woody]
503	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Nitrogen fixing woody plant? No. N-fixing, but non-woody] "It nodulates readily with native cowpea-type rhizobia. Germination is rapid and seedlings emerge 3 days after sowing, soon producing a thick ground cover that smothers weeds."
503	2010. Wu, Z.Y./Raven, P.H./Hong, D.Y. ( eds.). Flora of China. Vol. 10 (Fabaceae). Science Press Beijing, and Missouri Botanical Garden Press, St. Louis.,	[Nitrogen fixing woody plant? No. N-fixing, but non-woody] "Herbs, erect, 50–100 cm tall. Branches terete, ribbed, appressed silky pubescent."

504	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No]
601	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Evidence of substantial reproductive failure in native habitat? No] " <i>Crotalaria juncea</i> is generally considered to have originated in India, where it has been cultivated since prehistoric times (Montgomery 1954)."
602	2012. World Agroforestry Centre. AgroForestry Tree Database - <i>Crotalaria juncea</i> . PROSEA, <a href="http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618">http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618</a>	[Produces viable seed? Yes] "Seeds are ready for harvest when pods begin to turn yellow and seeds rattle in them. <i>C. juncea</i> is propagated by direct seeding."
603	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Hybridizes naturally? No] No evidence [Probably not - it is a widely studied species and there is no evidence of hybridization either for <i>C. juncea</i> or in the genus <i>Crotalaria</i> ]
604	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Self-compatible or apomictic? Yes] "The inflorescence is a terminal open raceme to 25 cm in length with deep yellow flowers. Flowering is indeterminate. Extensive cross pollination occurs in sunn hemp and self pollination takes place after the stigmatic surface has been insect or mechanically stimulated (Purseglove 1968)."
604	2012. World Agroforestry Centre. AgroForestry Tree Database - <i>Crotalaria juncea</i> . PROSEA, <a href="http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618">http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618</a>	[Self-compatible or apomictic? Yes] "Cross-pollination is extensive, and self pollination occurs only after the stigmatic surface has been stimulated by insects or some other means."
605	2012. World Agroforestry Centre. AgroForestry Tree Database - <i>Crotalaria juncea</i> . PROSEA, <a href="http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618">http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618</a>	[Requires specialist pollinators? No] "The wings and keel of the flower are articulated by a ball-and-socket joint. When large bees such as <i>Xylocopa</i> spp. And <i>Vegacitile</i> spp. alight on the wings, they catalyse the ball-and-piston mechanism that forces the stigma with a mass of pollen against the abdomen of the insect. In Brazil, bees have been found the most frequent pollinators, <i>Xylocopa frontalis</i> being the most frequent (49.7%), then <i>X. griseascens</i> (19.1%)."
606	2012. World Agroforestry Centre. AgroForestry Tree Database - <i>Crotalaria juncea</i> . PROSEA, <a href="http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618">http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SplD=618</a>	[Reproduction by vegetative fragmentation? No] " <i>C. juncea</i> is propagated by direct seeding."
607	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Minimum generative time (years)? <1] "Erect, herbaceous, laxly branched annual shrub, " ... "Plants remain succulent for 6 to 8 weeks after sowing, at which time flowering begins and stems begin to lignify."
701	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules likely to be dispersed unintentionally? No] "Pods cylindrical, 3-6 x 1 2 cm, tomentose, light brown, containing about 6 seeds. Seed heart-shaped, with narrow end strongly incurved, up to 6 mm long, dark brown to black." [Probably not - no evidence that the plants are grown in heavily trafficked areas, and both pods & seeds lack means of external attachment]
702	2010. Wu, Z.Y./Raven, P.H./Hong, D.Y. ( eds.). Flora of China. Vol. 10 (Fabaceae). Science Press Beijing, and Missouri Botanical Garden Press, St. Louis.,	[Propagules dispersed intentionally by people? Yes] " <i>Crotalaria juncea</i> is cultivated as a fiber crop ("Sunn Hemp") and as a green manure. It is widely naturalized in Africa, tropical and sub-tropical America, Asia, Australia, and Papua New Guinea. Its original distribution is probably S Asia."
703	1996. Cook, C.G./White, G.A.. <i>Crotalaria juncea</i> : A potential multi-purpose fiber crop. p. 389-394. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-389.html</a>	[Propagules likely to disperse as a produce contaminant? No] "As one of the most widely grown green manure crops throughout the tropics, sun hemp is often grown in rotation with several different crop species." - [however seeds are relatively large ( 6 mm in length) and hence not likely to be a contaminant.]
704	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules adapted to wind dispersal? No] "Pods cylindrical, 3-6 x 1-2 cm, tomentose, light brown, containing about 6 seeds. Seed heart-shaped, with narrow end strongly incurved, up to 6 mm long, dark brown to black." [No adaptations for wind dispersal]

705	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules water dispersed? No] "Pods cylindrical, 3-6 x 1-2 cm, tomentose, light brown, containing about 6 seeds. Seed heart-shaped, with narrow end strongly incurved, up to 6 mm long, dark brown to black." [No evidence that pods or seeds are dispersed by water]
706	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules bird dispersed? No] "Pods cylindrical, 3-6 x 1-2 cm, tomentose, light brown, containing about 6 seeds. Seed heart-shaped, with narrow end strongly incurved, up to 6 mm long, dark brown to black." [No evidence - a small herbaceous legume - the pods probably open and seeds disperse by gravity]
707	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules dispersed by other animals (externally)? No] "Pods cylindrical, 3-6 x 1-2 cm, tomentose, light brown, containing about 6 seeds. Seed heart-shaped, with narrow end strongly incurved, up to 6 mm long, dark brown to black." [No evidence, and both pods & seeds lack means of external attachment]
708	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Propagules survive passage through the gut? Unknown] "Laboratory tests and feeding trials with the Hawaiian variety, 'Tropics Sun', suggest that both seeds and forage of are nontoxic."
801	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Prolific seed production (>1000/m <sup>2</sup> )? No] "Because of the lateness in flowering, with the exception of Texas, very little seed production has occurred in the continental United States. The primary sources of seed for the sun hemp grown in the continental United States are from Hawaii and South America (most notably Brazil and Columbia). The short-day, frost-free environments of these locations allow for reliable and excellent yields of good quality seed to be produced." [Probably not. Relatively large seeds - 5 mm in length only produced in large numbers when cultivated]
802	1977. Pandey, B.N./Sinha, R.P.. Light as a Factor in Growth and Morphogenesis. I. Effect of Artificial Shading on <i>Crotalaria juncea</i> L. and <i>C. sericea</i> Retz.. New Phytologist. 79(2): 431-439.	[Evidence that a persistent propagule bank is formed (>1 yr)? No] "Seeds of <i>Crotalaria sericea</i> were scarified before sowing because they show seed-coat dormancy: <i>C. juncea</i> shows no dormancy and scarification was unnecessary."
803	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Well controlled by herbicides? Potentially Yes] "Related species susceptible to 2,4-D. Minimal phytotoxicity reported for several pre emergence herbicides including clomazone at 1.38 kg a.i./ha."
803	2010. Maddox, V./Westbrooks, R./Byrd, Jr., J.D.. Invasive Plant Atlas of the MidSouth - <i>Crotalaria spectabilis</i> . Mississippi State University, Mississippi State, MS <a href="http://www.gri.msstate.edu/ipams/species.php?CName&gt;Showy%20rattlebox">http://www.gri.msstate.edu/ipams/species.php?CName&gt;Showy%20rattlebox</a>	[Well controlled by herbicides? Potentially Yes. Related weedy species controlled with herbicides] "There are a number of chemical control options for showy rattlebox. These include both preemergence and postemergence herbicides in pasture and/or hay, corn, and soybeans. In pasture and/or hay, diuron can be used for preemergence control while dicamba, hexazinone, triclopyr, triclopyr mixes, 2,4-D, or 2,4-D mixes can be used for postemergence control. In corn, atrazine can be used for both preemergence and early postemergence control of showy rattlebox. Other postemergence options in corn include dicamba, clopyralid, glyphosate (only for Roundup Ready hybrids), or 2,4-D. Ametryn, linuron, or paraquat can be used postemergence directed in corn. In soybeans, flumioxazin or metribuzin can be used for preemergence control. Acifluorfen can be used for postemergence control, while fomesafen, glyphosate (only on Roundup Ready cultivars), Lactofen, or paraquat can be used postemergence directed control of showy rattlebox."
804	2005. Cook, B.G./Pengelly, B.C./Brown, S.D. et al.. Tropical Forages: an interactive selection tool., [CD-ROM],. SIRO, DPI&F(Qld), CIAT and ILRI, <a href="http://www.tropicalforages.info/index.htm">http://www.tropicalforages.info/index.htm</a>	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Plants remain succulent for 6 to 8 weeks after sowing, at which time flowering begins and stems begin to lignify. When grown for forage, <i>C. juncea</i> can be harvested 4 times, starting 6 - 8 weeks after sowing, and then every 4 weeks. This is also the best time to incorporate it as a green manure. More mature plants are set back by harvesting and may die or take some time for even partial recovery."
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown]

## **Summary of Risk Traits**

### **High Risk / Undesirable Traits**

- Naturalized on Oahu, East Maui, Hawaiian Islands, China, and elsewhere
- Broad climate suitability & thrives in tropical climates
- Potentially weedy
- Other *Crotalaria* species documented to be invasive
- Potentially toxic (although Hawaiian cultivar 'Tropics Sun' reportedly non-toxic)
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Capable of self-pollination
- Reaches maturity in <1 year
- Can tolerate repeated harvesting after 6-8 weeks of growth

### **Low Risk / Desirable Traits**

- Evidence of weediness or negative impacts unspecified or unverified
- Palatable to ungulates
- Useful as a green manure & cover crop to exclude weeds
- Used as a green fire break
- Shade-intolerant
- Seeds apparently do not persist in the soil
- Pods & seeds rely on human transport for dispersal