

Taxon: <i>Senna spectabilis</i> (DC.) H. S. Irwin & Barneby	Family: Fabaceae
Common Name(s): casia amarilla crown of gold tree spectacular cassia whitebark senna	Synonym(s): Cassia carnaval Spieg. Cassia excelsa Schrad. Cassia spectabilis DC.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 20 Sep 2019
WRA Score: 10.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Tropical Tree, Environmental Weed, Thicket-Forming, Non N-Fixing, Coppices

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	n
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		
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
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	y
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	n
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
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	y
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		
604	Self-compatible or apomictic		
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	2
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
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	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	y=1, n=-1	n
801	Prolific seed production (>1000/m ²)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
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)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence of domestication] "It is often planted for fuelwood, as an ornamental and as a shade tree in agroforestry situations. Although a legume, it is not a nitrogen-fixing species but is nevertheless useful for fodder, mulches, and as a honey source. Its rapid regeneration and growth make it a potential weed. The wood is of small dimensions, commonly used as fuelwood; posts; building poles; and general utility. Further research is needed on the cultural management of <i>S. spectabilis</i> ."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2019). 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. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Sep 2019]	"Native Northern America Mexico (s.e.) Southern America CENTRAL AMERICA: Central America (probably introd. most sites) NORTHERN SOUTH AMERICA: Venezuela BRAZIL: Brazil (n.e.) WESTERN SOUTH AMERICA: Bolivia (s.e.), Colombia, Peru (e.) SOUTHERN SOUTH AMERICA: Argentina, [Entre Ríos, Jujuy, Salta] Paraguay"
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>Senna spectabilis</i> is an attractive small- to medium-sized (to about 10 m tall) multi-stemmed tree, native to Central and South America and naturalized in many other parts of the humid tropics, particularly the Philippines and East and southern Africa."

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Sep 2019]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Climatic amplitude (estimates) - Altitude range: 900 - 1900 m - Mean annual rainfall: 800 - 2000 mm - Rainfall regime: bimodal; uniform - Dry season duration: 1 - 3 months - Mean annual temperature: 19 - 22°C - Mean maximum temperature of hottest month: 23 - 32°C - Mean minimum temperature of coldest month: 14 - 17°C - Absolute minimum temperature: > 10°C"
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . Cassia. Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 18 Sep 2019]	"USDA hardiness zones: 10B through 11"

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Sep 2019]	"Native Northern America Mexico (s.e.) Southern America CENTRAL AMERICA: Central America (probably introd. most sites) NORTHERN SOUTH AMERICA: Venezuela BRAZIL: Brazil (n.e.) WESTERN SOUTH AMERICA: Bolivia (s.e.), Colombia, Peru (e.) SOUTHERN SOUTH AMERICA: Argentina, [Entre Ríos, Jujuy, Salta] Paraguay Cultivated (also cult.) Naturalized Southern America CARIBBEAN: Barbados, Cuba, Dominican Republic, Guadeloupe, Haiti, Jamaica, Martinique, United States [Puerto Rico]"
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>Senna spectabilis</i> is an attractive small- to medium-sized (to about 10 m tall) multi-stemmed tree, native to Central and South America and naturalized in many other parts of the humid tropics, particularly the Philippines and East and southern Africa."

205	Does the species have a history of repeated introductions outside its natural range?	y
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Qsn #	Question	Answer
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"native to Central and South America and naturalized in many other parts of the humid tropics, particularly the Philippines and East and southern Africa." [Asia: Philippines - planted; Africa: East Africa - planted; Southern Africa -planted]
	Lau, A. and Frohlich, D. 2012. New plant records from O'ahu for 2009. Bishop Museum Occasional Papers 113: 7-26	"Senna spectabilis is a tropical American shrub or tree to 50 ft tall, which is rarely planted in Hawai'i."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Liogier, A.H. & Martorell, L.F. 2000. Flora of Puerto Rico and adjacent islands: a systematic synopsis. Second Edition Revised. La Editorial, UPR, San Juan, Puerto Rico	"naturalized in Puerto Rico"
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Sep 2019]	"Naturalized Southern America CARIBBEAN: Barbados, Cuba, Dominican Republic, Guadeloupe, Haiti, Jamaica, Martinique, United States [Puerto Rico]"
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Senna spectabilis is an attractive small- to medium-sized (to about 10 m tall) multi-stemmed tree, native to Central and South America and naturalized in many other parts of the humid tropics, particularly the Philippines and East and southern Africa."
	Lau, A. and Frohlich, D. 2012. New plant records from O'ahu for 2009. Bishop Museum Occasional Papers 113: 7-26	[Oahu] "Senna spectabilis (DC.) H.S. Irwin & Barneby New naturalized record Senna spectabilis is a tropical American shrub or tree to 50 ft tall, which is rarely planted in Hawai'i. It can be distinguished from other Senna in Hawai'i by the combination of the following characters: leaves without petiolar glands, flowers irregularly symmetrical where 1 petal is folded in over the stamens, 7 stamens per flower, and more or less cylindrical fruits (Staples & Herbst 2005). It is documented here as sparingly naturalized, spreading from planting sites into mesic gulches and roadside residential areas at Schofield Barracks. Material examined: O'AHU: Schofield Barracks, UTM 597310, 2377278. Seedlings of various sizes in Falcataria understory, sapling about 15 ft tall, no flowers seen. Fruits cylindrical, 18 Aug 2009, OED 2009081801"

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Llamas, K.A. 2003. Tropical Flowering Plants. Timber Press, Portland, OR	"Weedy in moist conditions." [Potential landscaping weed. An environmental weed in Africa. See 3.04]

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes

Qsn #	Question	Answer
	Snapp, S.S. & Pound, B. (2017). <i>Agricultural Systems. Agroecology and Rural Innovation for Development. Second Edition.</i> Academic Press, London	"This agroforestry species acts as a highly effective weed species, and has traits that maximize its ability to compete with cash crops. Promotion of <i>S. spectabilis</i> based on tremendous biomass production potential was an insufficient criteria, and may have been based on performance on research station trials, where soils of high organic matter may not have been representative of smallholder farm environments. Biological review of <i>S. spectabilis</i> , and testing on-farm, revealed the highly competitive nature of this species, and its unsuitability as an intercrop species." [Negative effects on agriculture when purposely planted, but not truly a "weed" of agriculture]
	Noordwijk M., Cadisch G., Ong, C.K. (eds.). (2004). <i>Below-ground Interactions in Tropical Agroecosystems Concepts and Models with Multiple Plant Components.</i> CABI Publishing, Wallingford, UK	[Crop yields reduced by planted <i>Senna</i> and <i>Leucaena</i> . Intentionally cultivated, and not a true weed] "The mechanistic basis of competition for water in agroforestry was demonstrated by Govindarajan et al. (1996) and McIntyre et al. (1997). Their experiments in a semiarid region of Kenya showed that, where seasonal rainfall was insufficient to recharge soil below the crop rooting zone, the grain yields of maize grown in alley cropping systems with <i>Senna spectabilis</i> or <i>Leucaena leucocephala</i> were reduced by between 39% and 95%. Without available water below the crop rooting zone, uptake by the hedges deprived the maize of much of the water required for growth. In such cases, higher water use by trees causes increased suppression of crop yields"

304	Environmental weed	y
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium.</i> CAB International, Wallingford, UK	"Its rapid regeneration and growth make it a potential weed."
	Nishida, T. (1996). Eradication of the invasive, exotic tree <i>Senna spectabilis</i> in the Mahale Mountains. <i>Pan Africa News</i> , 3(2): 6-7	"Mr. C.K Ruffo, a botanist with the National Tree Seed Programme, Morogoro, made a 3-day survey in February 1995 at park management request to identify the trees and assess the extent of the problem. Ruffo (3) concluded that <i>S. spectabilis</i> was threatening to colonize the entire area occupied by lowland and montane rain forest in Mahale National Park. From the perspective of the creation of park policy (1), the <i>S. spectabilis</i> invasion should be among the most serious problems for management to tackle."
	BioNET-EAFRINE. (2011). <i>Senna spectabilis</i> (Spectacular Cassia). https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Senna_spectabilis_(Spectacular_Cassia).htm . [Accessed 18 Sep 2019]	" <i>Senna spectabilis</i> can invade disturbed forests, forest edges and gaps where it can establish and suppress the regeneration of native species."

Qsn #	Question	Answer
	<p>Wakibara, J. V., & Mnaya, B. J. (2002). Possible control of <i>Senna spectabilis</i> (Caesalpinaceae), an invasive tree in Mahale mountains National Park, Tanzania. <i>Oryx</i>, 36(4), 357-363</p>	<p>"<i>Senna spectabilis</i> is a tree native to South and Central America. Thirty-five years ago it invaded the Mahale Mountains National Park in western Tanzania where it presently covers c. 225 ha. We quantified its occurrence relative to that of sympatric species of native trees, and compared girdling and felling as methods for its control in three 0.25 ha plots. Within invaded areas of forest this exotic species was both the most abundant and dominant of the 26 species of tree recorded. During 4 years of monitoring the experimental plots the abundance of <i>S. spectabilis</i> declined markedly in the plots where control methods were practised, but increased slightly in the unmanipulated plot. In contrast, the abundance of native tree species increased markedly in the plots where <i>S. spectabilis</i> had been removed or killed, with higher densities in the girdled rather than the felled plot. <i>S. spectabilis</i> appears to suppress the recruitment of native trees in the Park, and its removal can encourage regeneration of the degraded forest without the need for artificial seeding."</p>

305	Congeneric weed	y
	Source(s)	Notes
	<p>Weber, E. 2017. <i>Invasive Plant Species of the World</i>, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK</p>	<p>"<i>Senna alata</i> ... Where invasive it forms dense thickets, shading out all other plants and preventing any regeneration of native species. The shrub establishes quickly in disturbed sites. Heavy infestations may restrict access to water for livestock and wildlife (Parsons and Cuthbertson, 2001)." ... "<i>Senna didymobotrya</i> ... Christmas bush forms extensive and dense thickets climbing over native vegetation, impeding growth and regeneration of native species. The shrub grows abundantly along rivers and in savannas. Extensive thickets affect wildlife by reducing habitats and restricting access to water (Macdonald, 1983; Henderson, 2001). Little is known about the ecology of this plant as an invader."</p>
	<p>Weber, E. 2003. <i>Invasive Plant Species of the World</i>. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK</p>	<p><i>Senna alata</i>, <i>S. bicapsularis</i>, <i>S. didymobotrya</i>, <i>S. obtusifolia</i> [listed as significant weeds of natural areas]</p>

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	<p>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</p>	<p>[No evidence] "Trees, evergreen, small, 5–7(–10) m tall, with long, spreading branches. Young branches, petioles, and rachises of leaves densely yellowish brown velutinous. Leaves 12–30 cm; rachis and petiole without glands; leaflets 8–15(–19) pairs, elliptic or oblong-lanceolate, 3–7 × 1–2 cm (lowermost pair usually much smaller and early caducous), abaxially densely yellowish brown velutinous, adaxially glabrous or puberulent, base subrounded and slightly oblique, apex acute, cuspidate."</p>

402	Allelopathic	
	Source(s)	Notes

Qsn #	Question	Answer
	Wakibara, J. V. (1998). Observations on the pilot control of <i>Senna spectabilis</i> , an invasive exotic tree in the Mahale Mountains National park, Western Tanzania. <i>Pan Africa News</i> , 5(1): 4-6	[Possibly] "The plant is also suspected to have allelopathic properties (Ohigashi, pers. comm.). However, under controlled agronomic conditions, it was not found to be allelopathic to maize and rice (6)." ... "evidence for <i>Senna</i> allelopathy to natural vegetation at Mahale needs to be investigated in more detail"

403	Parasitic	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	"Trees, evergreen, small, 5–7(–10) m tall, with long, spreading branches." [Fabaceae. No evidence]

404	Unpalatable to grazing animals	y
	Source(s)	Notes
	Mungatana, E., & Ahimbisibwe, P. B. (2012). Qualitative impacts of <i>Senna spectabilis</i> on distribution of welfare: A household survey of dependent communities in Budongo Forest Reserve, Uganda. <i>Natural Resources Forum</i> 36(3): 181-191	" <i>S. spectabilis</i> is generally not popular with timber loggers, and is also largely unpalatable to forest herbivores including chimpanzees (NARO, 2004), factors that partially explain its rapid spread in the BFR." ... "The main costs that households associate with <i>S. spectabilis</i> are that it is unpalatable to livestock and that it harbors insect species harmful to human health."
	Wakibara, J. V., & Mnaya, B. J. (2002). Possible control of <i>Senna spectabilis</i> (Caesalpinaceae), an invasive tree in Mahale mountains National Park, Tanzania. <i>Oryx</i> , 36(4), 357-363	"unpalatable to ruminants"

405	Toxic to animals	n
	Source(s)	Notes
	Jothy, S. L., et al. (2012). <i>Cassia spectabilis</i> (DC) Irwin et Barn: A promising traditional herb in health improvement. <i>Molecules</i> , 17(9), 10292-10305	"Pharmacological studies by various groups of investigators have shown that <i>C. spectabilis</i> possesses significant biological activity, such as antibacterial, antibiofilm, antifungal and antioxidant properties. Beside this, toxicity studies of this plant have revealed no toxic effect on mice."
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[No evidence] "It is often planted for fuelwood, as an ornamental and as a shade tree in agroforestry situations. Although a legume, it is not a nitrogen-fixing species but is nevertheless useful for fodder, mulches, and as a honey source."

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"It is reported to be easier to raise, less susceptible to pests and diseases, and more drought-resistant than <i>Senna siamea</i> ."
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . <i>Cassia</i> . Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"No pests or diseases of major concern." ... "Pest resistance: long-term health usually not affected by pests"

Qsn #	Question	Answer
407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Toxic. Purgative, laxative, emetic, for skin diseases." [Unclear what toxic effects may be, and whether or not they affect humans]

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"It is a fast-growing species, particularly on deep soils, and is fire- and termite-resistant and tolerant of strongly acid soils."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	SelecTree. "Senna spectabilis Tree Record." 1995-2019. Sep 20, 2019. https://selectree.calpoly.edu/tree-detail/senna-spectabilis . [Accessed 20 Sep 2019]	"Exposure Full Sun"
	Gilman, E.F. & Watson, D.G. (1994). Senna spectabilis. Cassia. Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Light requirement: tree grows in full sun"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Soil descriptors - Soil texture: medium; heavy - Soil drainage: free - Soil reaction: very acid; acid; neutral - Special soil tolerances: shallow - Soil types: vertisols; ferralsols; fluvisols; nitisols"
	Gilman, E.F. & Watson, D.G. (1994). Senna spectabilis. Cassia. Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Soil tolerances: clay; loam; sand; slightly alkaline; acidic; well-drained"
	Orwa C., Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org . [Accessed 20 Sep 2019]	"Soil type: S. spectabilis grows in deep, moist, sandy or loamy soils but flourishes even in poor, black cotton soils."

Qsn #	Question	Answer
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	"Trees, evergreen, small, 5–7(–10) m tall, with long, spreading branches."

412	Forms dense thickets	y
	Source(s)	Notes
	Mungatana, E., & Ahimbisibwe, P. B. (2012). Qualitative impacts of <i>Senna spectabilis</i> on distribution of welfare: A household survey of dependent communities in Budongo Forest Reserve, Uganda. <i>Natural Resources Forum</i> 36(3): 181-191	"Out of the 82,530 ha of the BFR, <i>S. spectabilis</i> had covered more than 1,000 ha as of 2004 (NARO, 2004). Today, it covers about 20% of the BFR, and is mainly concentrated in one area of the reserve. It is also common along logging trails, where it forms homogeneous stands at the expense of other species, making the BFR one of the most <i>S. spectabilis</i> -invaded forests in Uganda."
	NARO. (2004). Implementation of invasive plant prevention and control programmes in Uganda. Report submitted to the CAB International Africa Regional Centre under the PDF-B phase of the UNEP/GEF Project: Removing Barriers to Invasive Plant Management in Africa. National Agricultural Research Organisation, Entebbe, Uganda	"The species is thought to have been introduced by the Indian Sawmill operators or introduced by Europeans for firewood in an attempt to preserve the forest. It is common mainly along logging trails/landing sites in the Budongo Forest, where it forms pure stands at the expense of other species. It has been used as boundary marker."

501	Aquatic	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Terrestrial] "It is a fast-growing species, particularly on deep soils, and is fire- and termite-resistant and tolerant of strongly acid soils."

502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 19 Sep 2019]	Family: Fabaceae (alt. Leguminosae) Subfamily: Caesalpinioideae Tribe: Cassieae Subtribe: Cassiinae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"Although a legume, it is not a nitrogen-fixing species but is nevertheless useful for fodder, mulches, and as a honey source."

Qsn #	Question	Answer
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	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	"Trees, evergreen, small, 5–7(–10) m tall, with long, spreading branches."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence] "Senna spectabilis is an attractive small- to medium-sized (to about 10 m tall) multi-stemmed tree, native to Central and South America and naturalized in many other parts of the humid tropics, particularly the Philippines and East and southern Africa."

602	Produces viable seed	y
	Source(s)	Notes
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . Cassia. Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Propagation is by seed."
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org . [Accessed 20 Sep 2019]	"Seed storage behaviour is orthodox; under cool dry conditions, seeds can be stored for up to 2 years. There are about 39 000 seeds/kg. Seeds are pretreated by immersing them in boiling water, allowing them to cool and soaking them for 24 hours."

603	Hybridizes naturally	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	Unknown. No evidence found

Qsn #	Question	Answer
604	Self-compatible or apomictic	
	Source(s)	Notes
	Manente-Balestieri, F. C., & Machado, V. L. (1999). Flowering entomofauna in <i>Cassia spectabilis</i> (L.) D C. (Leguminosae). <i>Anais da Sociedade Entomológica do Brasil</i> , 28(3), 429-437	"A test for manual pollination suggested that <i>C. spectabilis</i> is autocompatible, but xenogamy is the predominant system of reproduction." [Reference in contrast to de Lima Leite & Machado, 2010. May be self-compatible, but outcrossing may be the primary method of reproduction]
	de Lima Leite, A. V., & Machado, I. C. (2010). Reproductive biology of woody species in Caatinga, a dry forest of northeastern Brazil. <i>Journal of Arid Environments</i> , 74(11), 1374-1380	"Table 1 Number of studied individuals, floral longevity, sexual system, pollination tests, Index of Self Incompatibility (ISI), breeding system and incompatibility in 15 woody species in Caatinga, Boa Vista, Paraíba, Brazil." [Senna spectabilis - SI: self-incompatible, LSI: late-acting self-incompatible]

605	Requires specialist pollinators	n
	Source(s)	Notes
	NARO/UNEP/GEF/IAS. (2006). Socio-economic seminar on the <i>Senna spectabilis</i> . Nyabyeya Forestry College	"It flowers all the time. Therefore its good for pollination (attracts bees)." [Floral structure entomophilous]
	Manente-Balestieri, F. C., & Machado, V. L. (1999). Flowering entomofauna in <i>Cassia spectabilis</i> (L.) D C. (Leguminosae). <i>Anais da Sociedade Entomológica do Brasil</i> , 28(3), 429-437	"Studies on reproduction of <i>Cassia spectabilis</i> (L.) and on diversity, frequency and constancy of the insects visiting the Leguminosae at different hours were carried out. Observations in the field concerned insect behavior and were followed by their captures, and influence of the abiotic factors was recorded. A pollen viability test showed that 98% was positive. A test for manual pollination suggested that <i>C. spectabilis</i> is autocompatible, but xenogamy is the predominant system of reproduction. Inflorescences were visited by a large number of insects, with predominance of bees. The visiting time of flowers of <i>C. spectabilis</i> by insects had a peak between 8 and 14 h and the lowest occurrence period were between 7 and 8 h and 17 and 18 h. While <i>Xylocopa frontalis</i> Olivier, <i>X. suspecta</i> Camargo & Moure, <i>Bombus morio</i> Swederus and <i>Centris scopipes</i> Friese have the morphology and the behavior adapted for pollinators legitimate; <i>C. similis</i> F., <i>Oxaea flavescens</i> Klug and <i>Epicharis rustica flava</i> Cockerell were considered occasional pollinators. <i>Pseudaugochloropsis graminea</i> (F.), <i>Tetragonisca angustula</i> Latreille and <i>A. mellifera</i> L. were considered pirates or robbers. The "buzz pollination" is the method used by the bees to pollen collect."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"- Vegetative propagation by cuttings- Stand establishment using stump plants; direct sowing; planting stock" [No evidence of vegetative spread, but coppices freely...see Question 8.04]

607	Minimum generative time (years)	2
	Source(s)	Notes

Qsn #	Question	Answer
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . <i>Cassia</i> . Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Growth rate: fast"
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"Its rapid regeneration and growth make it a potential weed."
	NARO. (2004). Implementation of invasive plant prevention and control programmes in Uganda. Report submitted to the CAB International Africa Regional Centre under the PDF-B phase of the UNEP/GEF Project: Removing Barriers to Invasive Plant Management in Africa. National Agricultural Research Organisation, Entebbe, Uganda	"Senna is extremely fast-growing and flowers and sets seed precociously and profusely."
	WRA Specialist. (2019). Personal Communication	Due to reported fast growth rate and precocious flowering, time to maturity speculated to occur between the second and third year of growth

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	NARO/UNEP/GEF/IAS. (2006). Socio-economic seminar on the <i>Senna spectabilis</i> . Nyabyeya Forestry College	"S. Spectabilis seeds were probably picked in the mud and carried into Budongo Forest by trucks from and to the saw mills established in the forest in the late 1950s. As further evidence to this theory, today the <i>S. Spectabilis</i> trees are concentrated along the management roads."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"It is often planted for fuelwood, as an ornamental and as a shade tree in agroforestry situations."
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . <i>Cassia</i> . Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Outstanding tree: tree has outstanding ornamental features and could be planted more"

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	NARO/UNEP/GEF/IAS. (2006). Socio-economic seminar on the <i>Senna spectabilis</i> . Nyabyeya Forestry College	"In addition the roots are known to germinate and the tree also coppices when cut down."
	Luz, G. R., & Ferreira-Nunes, Y. R. (2014). Seed germination of arboreal shrub species with different dispersal mechanisms in a Brazilian tropical dry forest. <i>Tropical Dry Forests in the Americas: Ecology, Conservation, and Management</i> , 281-299. CRC Press, Boca Raton, FL	"The fruits are indehiscent legumes, black or dark brown, with large amounts (13–20) of small autochorous seeds (Barbosa et al. 2003; Maia 2004)."

704	Propagules adapted to wind dispersal	n
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Qsn #	Question	Answer
	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	"Legume pendulous, black, narrowly cylindric, slightly compressed, 25–35 × 1–1.5 cm, slightly contracted between seeds, annulate-septate, glabrous. Seeds 50–70, suborbicular, ca. 5 mm in diam."

705	Propagules water dispersed	y
	Source(s)	Notes
	NARO/UNEP/GEF/IAS. (2006). Socio-economic seminar on the <i>Senna spectabilis</i> . Nyabyeya Forestry College	" <i>S. Spectabilis</i> produces large quantities of seed that do not die easily and therefore spreads fast. When the pod falls down, it bursts and the seeds are easily dispersed by water."

706	Propagules bird dispersed	n
	Source(s)	Notes
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . Cassia. Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Fruit characteristics: does not attract wildlife; inconspicuous and not showy"
	Luz, G. R., & Ferreira-Nunes, Y. R. (2014). Seed germination of arboreal shrub species with different dispersal mechanisms in a Brazilian tropical dry forest. <i>Tropical Dry Forests in the Americas: Ecology, Conservation, and Management</i> , 281-299. CRC Press, Boca Raton, FL	"The fruits are indehiscent legumes, black or dark brown, with large amounts (13–20) of small autochorous seeds (Barbosa et al. 2003; Maia 2004)."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Gilman, E.F. & Watson, D.G. (1994). <i>Senna spectabilis</i> . Cassia. Fact Sheet ST-588. IFAS, University of Florida, Gainesville, FL. http://hort.ufl.edu . [Accessed 20 Sep 2019]	"Fruit characteristics: does not attract wildlife; inconspicuous and not showy; no significant litter problem; persistent on the tree" [No means of external attachment]
	Luz, G. R., & Ferreira-Nunes, Y. R. (2014). Seed germination of arboreal shrub species with different dispersal mechanisms in a Brazilian tropical dry forest. <i>Tropical Dry Forests in the Americas: Ecology, Conservation, and Management</i> , 281-299. CRC Press, Boca Raton, FL	"The fruits are indehiscent legumes, black or dark brown, with large amounts (13–20) of small autochorous seeds (Barbosa et al. 2003; Maia 2004)."

Qsn #	Question	Answer
708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Mungatana, E., & Ahimbisibwe, P. B. (2012). Qualitative impacts of <i>Senna spectabilis</i> on distribution of welfare: A household survey of dependent communities in Budongo Forest Reserve, Uganda. <i>Natural Resources Forum</i> 36(3): 181-191	[Unlikely to be consumed] " <i>S. spectabilis</i> is generally not popular with timber loggers, and is also largely unpalatable to forest herbivores including chimpanzees (NARO, 2004), factors that partially explain its rapid spread in the BFR." ... "The main costs that households associate with <i>S. spectabilis</i> are that it is unpalatable to livestock and that it harbors insect species harmful to human health."

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide</i> version 4.0. http://www.worldagroforestry.org . [Accessed 20 Sep 2019]	" <i>Senna spectabilis</i> is a small, rounded deciduous tree, 7-10 m (max. 15) tall, and 30 cm in trunk diameter, with a spreading crown." ... "Seeds 2.5 cm each division, 50-70, suborbicular, flattened, brown, about 5 mm in diameter; septae papery." [Probably does not achieve such high seed densities, but numbers unknown]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide</i> version 4.0. http://www.worldagroforestry.org . [Accessed 20 Sep 2019]	"Seed storage behaviour is orthodox; under cool dry conditions, seeds can be stored for up to 2 years." [Longevity under natural conditions unknown]
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"Seed storage orthodox"
	Luz, G. R., & Ferreira-Nunes, Y. R. (2014). Seed germination of arboreal shrub species with different dispersal mechanisms in a Brazilian tropical dry forest. <i>Tropical Dry Forests in the Americas: Ecology, Conservation, and Management</i> , 281-299. CRC Press, Boca Raton, FL	"Seed viability can last longer than 6 months, and radicle emergence occurs after 10–30 days; germination rates are usually lower than 30% (Lorenzi 1992). Therefore, scarification treatments may increase germination rates (Lorenzi 1992)."

803	Well controlled by herbicides	y
	Source(s)	Notes
	BioNET-EAFRINE. (2011). <i>Senna spectabilis</i> (Spectacular Cassia). https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Senna_spectabilis_(Spectacular_Cassia).htm . [Accessed 20 Sep 2019]	"Cut stump treatment using suitable herbicides including Tordon can be used to control <i>S. spectabilis</i> ."

Qsn #	Question	Answer
	NARO. (2004). Implementation of invasive plant prevention and control programmes in Uganda. Report submitted to the CAB International Africa Regional Centre under the PDF-B phase of the UNEP/GEF Project: Removing Barriers to Invasive Plant Management in Africa. National Agricultural Research Organisation, Entebbe, Uganda	"Mechanical control methods should be considered backed by appropriate studies. Arboricides are likely to be a more efficient option. However, there is concern about their possible negative environmental effects."
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	Several <i>Senna</i> species effectively controlled by various herbicides.

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	NARO/UNEP/GEF/IAS. (2006). Socio-economic seminar on the <i>Senna spectabilis</i> . Nyabyeya Forestry College	"In addition the roots are known to germinate and the tree also coppices when cut down."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Silvicultural characteristics descriptors - Tolerates drought; fire - Ability to coppice; pollard ... Its rapid regeneration and growth make it a potential weed."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Lau, A. and Frohlich, D. 2012. New plant records from O'ahu for 2009. Bishop Museum Occasional Papers 113: 7-26	[Unknown] "it is documented here as sparingly naturalized, spreading from planting sites into mesic gulches and roadside residential areas at Schofield Barracks. Material examined: O'AHU: Schofield Barracks, UTM 597310, 2377278. Seedlings of various sizes in <i>Falcataria</i> understory, sapling about 15 ft tall, no flowers seen."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates
- Naturalized on Oahu, (Hawaiian Islands) as well as the Philippines and East and southern Africa
- An environmental weed in Tanzania, and perhaps elsewhere in Africa, forming dense stands and excluding native vegetation
- Other *Senna* (and *Cassia* specie) are invasive
- Unpalatable to browsing and grazing animals
- Tolerates many soil types
- Forms dense thickets
- Reproduces by seeds
- Rapid growth
- Seeds dispersed by mud stuck to vehicles, by water, gravity and intentionally by people
- Able to coppice and resprout after cutting

Low Risk Traits

- Unarmed (no spines, thorns, or burrs)
- Requires full sun (may prevent spread into intact forests)
- Not nitrogen fixing
- Not reported to spread vegetatively
- Herbicides may provide effective control