

Family: *Apocynaceae*

Taxon: *Rauvolfia vomitoria*

Synonym: *Rauvolfia senegambiae* DC.
Hylacium owariense Afzel.

Common Name Poison devil's-pepper
swizzle stick

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation:	H(Hawai'i)
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score	21
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)		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)		
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)		y
304	Environmental weed		n=0, y = 2*multiplier (see Appendix 2)		y
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)		
401	Produces spines, thorns or burrs		y=1, n=0		n
402	Allelopathic		y=1, n=0		n
403	Parasitic		y=1, n=0		n
404	Unpalatable to grazing animals		y=1, n=-1		
405	Toxic to animals		y=1, n=0		y
406	Host for recognized pests and pathogens		y=1, n=0		y
407	Causes allergies or is otherwise toxic to humans		y=1, n=0		y
408	Creates a fire hazard in natural ecosystems		y=1, n=0		n
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0		y
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	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	y=1, n=-1	
604	Self-compatible or apomictic	y=1, n=-1	
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	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	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	
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	n
Designation: H(Hawai'i)		WRA Score	21

Supporting Data:

101	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	No evidence that <i>Rauvolfia vomitoria</i> is highly domesticated.
201	1989. Keay, R.W.J.. <i>Trees of Nigeria</i> . Clarendon Press, Oxford, UK	"Extends from Senegal to Egypt, East Africa, Zaire, and Gabon"
201	2002. Omino, E.A.. Entry for <i>Rauvolfia vomitoria</i> Afzel. <i>Flora of Tropical East Africa</i> . http://plants.jstor.org/flora/ftea006055	widespread in tropical Africa from Senegal to Sudan and South to Angola
201	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Native : Cameroon, Democratic Republic of Congo, Ghana, Liberia, Nigeria, Senegal, Sudan, Uganda
202	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Native : Cameroon, Democratic Republic of Congo, Ghana, Liberia, Nigeria, Senegal, Sudan, Uganda
203	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. <i>Rauvolfia L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII</i> . Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België. 61 (1/2): 21-69.	Ecology: Along roadsides; in scrub vegetation and secondary forests; altitude 0-1600 m; flowering and fruiting almost throughout the year, usually less abundant or even flowers absent in the rainy season. [elevational distribution >1000 m]
204	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Native : Cameroon, Democratic Republic of Congo, Ghana, Liberia, Nigeria, Senegal, Sudan, Uganda
205	1965. Neal, M.C. In <i>Gardens of Hawaii</i> . Bishop Museum Press, Honolulu, HI	"...Three species have been introduced. The three are: <i>R. serpentina</i> Benth., an Indian shrub from 0.5 to 3 feet high, <i>R. vomitoria</i> Afzel., to 20 feet high from Africa...The first two are being grown experimentally for the medicine they yield" [Hawaiian Islands]
205	1995. Ping-tao, L./Leeuwenberg, A. J. M./Middleton, D. J.. <i>Apocynaceae</i> . <i>Flora of China</i> . 16: 143–188..	S Guangdong, S Guangxi, S Yunnan [planted in China]
205	2000. Liogier, A. H./ Martorell, L. F.. <i>Flora of Puerto Rico and adjacent islands: a systematic synopsis</i> . La Editorial, UPR, San Juan, Puerto Rico	native to tropical Africa, reported as naturalized in Puerto Rico by M. Vives.
301	2000. Liogier, A. H./ Martorell, L. F.. <i>Flora of Puerto Rico and adjacent islands: a systematic synopsis</i> . La Editorial, UPR, San Juan, Puerto Rico	A native to tropical Africa, reported as naturalized in Puerto Rico by M. Vives.
301	2008. Purell, Melora K.. <i>Pers. Comm.</i> 09 Aug. - Coordinator Kohala Watershed Partnership. Coordinator@kohalawatershed.org	An incipient population of <i>Rauvolfia vomitoria</i> Afzelius (APOCYNACEAE) (poison devil's pepper or swizzle stick) is present in North Kohala, Hawaii island, within an area of about 2000-3000 acres...It was first noticed by field workers about ten years ago, and became a concern within the past year as its spread became uncontrollable. Its source is unknown, but it is possibly from an historic medicinal garden. The tree is spreading rapidly, and has invaded pastures, gulches and closed-canopy alien and mixed alien-ohia forest in North Kohala. The current distribution is from about 600 ft to 1600 ft elevation, from Makapala to 'Iole in North Kohala.

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- 301 2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19–26.
- "New naturalized record The following report is paraphrased from Melora K. Purell, Coordinator of the Kohala Watershed Partnership on the Big Island, who sent an email alert to the conservation community in August 2008 reporting on the incipient outbreak of *R. vomitoria*, poison devil'spepper or swizzle stick, on 800–1200 ha (2000–3000 acres) in North Kohala, Hawai'i Island. First noticed by field workers in North Kohala about ten years ago, swizzle stick has become a growing concern within the past year, as the tree has spread rapidly and invaded pastures, gulches, and closed-canopy alien and mixed alien-'ōhi'a forest in North Kohala, where it grows under the canopies of eucalyptus, strawberry guava, common guava, kukui, albizia, and 'ōhi'a. The current distribution is from 180–490 m (600–1600 ft) elevation, from Makapala to 'Iole. It has not yet been reported in the native forest mauka of its current infestation, nor has it been detected in the adjacent Kohala State Forest Reserve or the Pu'u o Umi Natural Area Reserve, but no surveys have yet been conducted. The source area is unknown but could possibly be a historic medicinal garden in the area. *Rauvolfia vomitoria* is a shrub or tree 0.5–20.0 m tall with leaves in whorls of 3–5; the blades are elliptic, sometimes narrowly so, 3.4–27.0 cm long, 2–9 cm wide, apiculate, with 8–17 pairs of arcuate-ascending secondary veins; the petiole is 6–35 mm long. The inflorescence consists of up to 4 whorls of dense, 15–450 flowered cymes, the inflorescence branches puberulent. The flowers are fragrant, 5-parted, greenish white to yellow; the tube 5.8–10.0 mm long, glabrous outside, the corolla lobes 1.1–2.1 mm long. The drupes are bright orange or red, globose to ellipsoid, 8–14 mm long, up to 9 mm in diameter, with usually only one mericarp developing (omino 2002; Li et al. 1995). Swizzle stick is described as widespread in tropical Africa from Senegal to Sudan and south to Angola in moist forest and forest margins (omino 2002) and has been collected from sea level to 1750 m (5740 ft) (Missouri Botanical Garden 2008a). The plant is a nitrogen-fixer and contains medicinal alkaloids (World Agroforestry Centre 2008). It is cultivated as a medicinal plant in China, where it is described as a plant with all parts poisonous, the roots and leaves with emetic and cathartic properties, the bark used to remedy fever and indigestion (Li et al. 1995)...The Bishop Museum's Herbarium Pacificum (BISH) currently houses just a single Hawaiian voucher of *Rauvolfia vomitoria*, a cultivated specimen collected at the McBryde Garden, National Tropical Botanical Garden, on Kaua'i in 2002 (Lorence et al. 8854). The label notes that the specimen originated from an airlayer taken from a plant growing at Limahuli Garden, Kaua'i. BISH has no vouchers from anywhere else in the Pacific basin. An unconfirmed living specimen (Acc. #77.399, originally from Uganda) is apparently planted at Ho'omaluhia Botanical Garden in windward o'ahu. Material examined. HAWAI'I: North Kohala, Makapala ahupua'a, near 'A'amakāō Gulch, 277 m (910 ft), 8 Aug 2008, M. Purell s.n. (BISH 734216)."
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- 302 1988. Steentoft, M.. Flowering Plants in West Africa. Cambridge University Press, Cambridge, UK
- "When fallow periods are reduced to two to four years, the number of species present is also reduced, and only thicket is formed before the onset of the next farming period. Weed species, of both woody and herbaceous kinds, predominate, accompanied by oil palms, *Combretum* spp. and *Trema guineensis*. *Rauvolfia vomitoria* is one of the last species to disappear when the regime is prolonged"
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- 302 1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. *Rauvolfia* L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België. 61 (1/2): 21-69.
- Ecology: Along roadsides; in scrub vegetation and secondary forests; altitude 0-1600 m [*R. vomitoria*, as a pioneer species, has the attributes of a disturbance weed]
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303	2008. Purell, Melora K.. Pers. Comm. 09 Aug. - Coordinator Kohala Watershed Partnership. Coordinator@kohalawatershed.org	"Aloha kakou, An incipient population of <i>Rauvolfia vomitoria</i> Afzelius (APOCYNACEAE) (poison devil's pepper or swizzle stick) is present in North Kohala, Hawaii island, within an area of about 2000-3000 acres. This tree is native to central tropical Africa, and in its home range it is endangered. The plant is a nitrogen-fixer, and contains medicinal alkaloids (World Agroforestry Centre database at http://www.worldagroforestry.org/sea/Products/AFDbases/AF/asp/SpeciesInfo.asp?SpID=768). It is cultivated in China and Puerto Rico. Its home range is from Liberia to Cameroon (up to 8 deg N lat), and it has been collected from sea level to 5800 feet (MBG Herbarium database). It has not yet been officially recorded in Hawaii or elsewhere in the Pacific as far as I can tell: (Please confirm). It was first noticed by field workers about ten years ago, and became a concern within the past year as its spread became uncontrollable. Its source is unknown, but it is possibly from an historic medicinal garden. The tree is spreading rapidly, and has invaded pastures, gulches and closed-canopy alien and mixed alien ohia forest in North Kohala. The current distribution is from about 600 ft to 1600 ft elevation, from Makapala to 'Iole in North Kohala. The plant has been positively identified by Dr. Greg Koob, State Biologist for NRCS, and I am preparing an herbarium specimen and will send it to Bishop Museum. The photos attached here were taken on Friday, 8/8/08, on a site visit with James Leary (UH-Manoa); David Clausnitzer, Lori Metz, and Matt Wung (all NRCS-Waimea field office); Sophia Schweitzer and Rick Gordon (Kohala Preserve Conservation Trust: KPCT). They share my deep concern and call to action. Currently the only control for this invasive tree has been limited mechanical control: mowing and cutting. (Workers have reported "feeling woozy" after cutting the trees - the alkaloids may be the cause?) The tree responds vigorously after cutting, with numerous new stems arising from the cut stump. (It reminds me of the vigorous sprouting of strawberry guava after cutting.) It grows very quickly. After mowing, re sprouts reach a height of 3-4 feet within two months. Trees aged 5-8 years are 30 feet tall, and covered in fruit. One grove of fruiting trees in the photo below had a flock of 100+ mynah birds consuming the fruit. In its home range, the seeds are bird-dispersed. In the disturbed areas and gulches in this part of North Kohala, the tree is growing under the canopies of eucalyptus, strawberry guava, common guava, kukui, albizia and 'ohia. It is extremely shade tolerant, and even under dense canopies, its growth rate exceeds all of those trees, and it is forming thickets in the understory. The seeds appear to germinate quickly, but the seed life is unknown. Its spread has not yet reached the native forest mauka of it current infestation, and it has not yet been detected in the adjacent Kohala State Forest Reserve or the Pu'u O Umi Natural Area Reserve, although species specific surveys have not been conducted. My opinion is that <i>Rauvolfia vomitoria</i> represents a severe threat to both agriculture and natural areas in Hawaii, and this population is a prime target for a coordinated rapid response. I would like to call upon all of you and your respective agencies to act quickly to contain this infestation, and eradicate this population before it spreads any further. The landowners are supportive of control, but do not have the personnel or resources to combat this alone." [R. vomitoria is demonstrating the potential to become a serious agricultural or horticultural weed]
303	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19-26.	" <i>Rauvolfia vomitoria</i> represents a severe threat to both agriculture and natural areas in Hawai'i, and the North Kohala population should be a prime target for a coordinated rapid response."
304	2008. Purell, Melora K.. Pers. Comm. 09 Aug. - Coordinator Kohala Watershed Partnership. Coordinator@kohalawatershed.org	Becoming a serious weed of the Kohala Mountains Watershed [see question 3.03 for further detail]
304	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19-26.	" <i>Rauvolfia vomitoria</i> represents a severe threat to both agriculture and natural areas in Hawai'i, and the North Kohala population should be a prime target for a coordinated rapid response."
305	1956. Rao, A.S.. A Revision of <i>Rauvolfia</i> With Particular Reference to the American Species. <i>Annals of the Missouri Botanical Garden</i> . 43 (3): 253-354.	The large-scale of <i>R. tetraphylla</i> plants in some areas, and their spreading as weeds in India, and more recently in Australia, should also afford ideal opportunity for a detailed field study of variation in this species.

305	2006. Care Earth. Rapid Assessment of Biodiversity on the Campus of Indian Institute of Technology - Madras. Indian Institute of Technology, Madras, India	Naturalized plants that have already become invasive on the Campus are mainly trees such as <i>Prosopis juliflora</i> , <i>Cassia siamea</i> , <i>Cassia javanica</i> and <i>Polyalthia longifolia</i> . Amongst the shrubs, <i>Antigonon leptopus</i> , <i>Cereus peruvianus</i> and <i>Rauvolfia tetraphylla</i> (see photo) are invasive. Of these, the former two species have been identified as invasive in GNP too, where their spread is apparently favoured by shade (Raman et al, 1995). <i>Rauvolfia tetraphylla</i> , a shrub that bears attractive red berries, has similarly invaded parts of the Campus taking advantage of the shade. <i>Parthenium hysterophorus</i> is generally considered an invasive.
305	2007. Randall, R.P.. Global compendium of weeds - <i>Rauvolfia ligustrina</i> [Online Database]. Hawaiian Ecosystems at Risk (HEAR), http://www.hear.org/gcw/species/rauvolfia_ligustrina/	<i>Rauvolfia ligustrina</i> listed as an agricultural weed
305	2007. Randall, R.P.. Global Compendium of Weeds - <i>Rauvolfia salicifolia</i> [Online Database]. Hawaii Ecosystems at Risk Project (HEAR), http://www.hear.org/gcw/species/rauvolfia_salicifolia/	<i>Rauvolfia salicifolia</i> listed as an agricultural weed
305	2008. Weber, E./Sun, S.-G./Li, B.. Invasive alien plants in China: diversity and ecological insights. <i>Biological Invasions</i> . 10: 1411–1429.	<i>Rauvolfia cubana</i> listed among the Invasive alien plant species in China [no evidence or description of impacts]
401	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. <i>Rauvolfia</i> L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. <i>Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België</i> . 61 (1/2): 21-69.	Shrub or tree, 0.50-20 (40) m high; trunk 1-80 cm in diam.; bark smooth, striated or fissured, light to dark grey-brown or dark brown; wood light yellowish to white; branches pale to dark brown, or grey-brown, smooth, lenticellate; branchlets in whorls of 3-5, pale to greenish-brown, smooth. Leaves in whorls of 3-5, those of a whorl subequal or unequal in size and shape (largest 2.5-5 x as long as smallest), glabrous; petiole 0.6-3.5 cm long; lamina herbaceous to subcoriaceous, sometimes papery, elliptic to narrowly elliptic, 2-3 x as long as wide, 3.4-27 x 2-9 cm, apiculate at the apex, acumen 1-18 mm long, with 8-17 pairs of secondary veins. [no spines, thorns, or burrs]
402	1958. Clayton, W.D.. Secondary Vegetation and the Transition to Savanna Near Ibadan, Nigeria. <i>The Journal of Ecology</i> . 46 (2): 217-238.	Several other species associated with and growing under <i>Rauvolfia vomitoria</i> . [no evidence of allelopathy]
403	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. <i>Rauvolfia</i> L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. <i>Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België</i> . 61 (1/2): 21-69.	Shrub or tree, 0.50-20 (40) m high [not parasitic]
404	1980. Mecha, I/Adegbola, T.A.. Chemical composition of some southern Nigeria forage eaten by goats. Browse in Africa. Addis Ababa, Ethiopia. International Livestock Centre for Africa,	Data from chemical analyses of 44 spp. Are presented. DM was in the range 31.4-34.2%. Mean CP content was higher for trees, shrubs and herbs than for grasses and varied from 10.07% in <i>Mangifera indica</i> to 37.87% in <i>Albizia ferruginea</i> . CF varied from 9.3% in <i>Rauvolfia vomitoria</i> to 40.7% in <i>A. ferruginea</i> .
404	1981. McKey, D.B./Gartlan, J.S./Waterman, P.G./Choo, C.M.. Food selection by black colobus monkeys (<i>Colobus satanas</i>) in relation to plant chemistry. <i>Biological Journal of the Linnean Society</i> . 16: 115–146.	"McKey et al. (1981) found that black colobus (<i>Colobus satanas</i>) can consume appreciable quantities of the alkaloid-rich leaves of <i>Rauvolfia vomitoria</i> that would be lethal to non-adapted folivores."
404	1994. Davies, A.G./Oates, J. F.. <i>Colobine Monkeys: Their Ecology, Behaviour and Evolution</i> . Cambridge University Press, Cambridge, UK	"Although no direct evidence of detoxification is available for colobines, the capacity of <i>Colobus satanas</i> to exploit the leaves of <i>Rauvolfia vomitoria</i> (Apocynaceae) despite the presence of a number of potentially toxic indole alkaloids can be explained by rumen detoxification." [may require specialized digestion to become palatable]
404	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Not a preferred browse species
405	1981. McKey, D.B./Gartlan, J.S./Waterman, P.G./Choo, C.M.. Food selection by black colobus monkeys (<i>Colobus satanas</i>) in relation to plant chemistry. <i>Biological Journal of the Linnean Society</i> . 16: 115–146.	"black colobus (<i>Colobus satanas</i>) can consume appreciable quantities of the alkaloid-rich leaves of <i>Rauvolfia vomitoria</i> that would be lethal to non-adapted folivores." [Toxic to non-adapted folivores]

406	1995. Orok, E.J./Ekpo, M. U./Larbi, A.. Insect pests of some exotic and indigenous browse species in southeastern Nigeria. <i>Agroforestry Systems</i> . 29(1): 37-45.	"Abstract During the period February to July 1992 the incidence of attacks by insect pests on ten cultivated browse species was studied at Obio Akpa, located in humid southeastern Nigeria. Two of the browse species <i>Gliricidia sepium</i> and <i>Leucaena leucocephala</i> were exotic and eight <i>Alchornea cordifolia</i> , <i>Baphia nitida</i> , <i>Rauvolfia vomitoria</i> , <i>Diallum guineensis</i> , <i>Ficus capensis</i> , <i>Glyphaea brevis</i> , <i>Homalium aylmeri</i> and <i>Manniophytum fulvum</i> indigenous. Forty insect pests were collected and 33 identified. Those identified belonged to either the order Coleoptera, Heteroptera, Lepidoptera or Orthoptera. Some of the insects were browse-specific, while others attacked several browse species. None of the browse species was free from insect attacks."
406	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	"The tree is a wild host of the pathogen causing 'collar crack' of cacao. Despite these reports it is used as a shade bearer for young cacao trees and as a support for vanilla in Gabon. "
407	1995. Ping-tao, L./Leeuwenberg, A. J. M./Middleton., D. J.. Apocynaceae. <i>Flora of China</i> . 16: 143–188..	"Cultivated for medicine. All parts are poisonous. The roots and leaves are reported to have emetic and cathartic properties, and the bark is used as a remedy for fever and indigestion."
407	2008. BoDD. The Botanical Dermatology Database. http://bodd.cf.ac.uk/BotDermFolder/BotDermA/AF OC-3.html	" <i>Rauvolfia vomitoria</i> Afzel. 2,6-Dimethoxy-1,4 benzoquinone, a known contact allergen, has been reported to occur in this species "
407	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. <i>Bishop Museum Occasional Papers</i> . 107: 19–26.	Workers have reported "feeling woozy" after cutting the trees, possibly related to the species' poisonous properties.
407	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	"The members of this family usually have toxic properties. In Gabon, the bark and root powder, are mixed with water or palm oil to kill fleas and vermin. The root bark extracts are reportedly poisonous."
408	1998. Friis, I./Vollesen, K./Danske, K.. <i>Flora of the Sudan-Uganda Border Area East of the Nile: catalogue of vascular plants</i> . Kgl. Danske Videnskabernes Selskab, Denmark	lowland rain forest [No evidence that this species creates a fire hazard, and unlikely given native rainforest habitat]
409	2008. Purell, Melora K.. <i>Pers. Comm.</i> 09 Aug. - Coordinator Kohala Watershed Partnership. Coordinator@kohalawatershed.org	In the disturbed areas and gulches in this part of North Kohala, the tree is growing under the canopies of eucalyptus, strawberry guava, common guava, kukui, albizia and 'ohia. It is extremely shade tolerant, and even under dense canopies, its growth rate exceeds all of those trees, and it is forming thickets in the understory.
409	2009. Cai, Z.Q./Wang, W.H./Yang, J./Cai, C.T.. Growth, photosynthesis and root reserpine concentrations of two <i>Rauvolfia</i> species in response to a light gradient. <i>Industrial Crops and Products</i> . 30: 220–226.	<i>R. vomitoria</i> can be described as a high-light demanding species, displaying a peak growth rate at 75% sunlight and declining slightly at 100% sunlight...The high magnitude of variations in photosynthetic rate in relation to a light gradient would point to a competitive advantage for <i>R. vomitoria</i> over <i>R. verticillatae</i> in rapidly changing light environments...When light was low, seedlings of both <i>Rauvolfia</i> species increased leaf area ratio through an increase in specific leaf area and leaf mass fraction. On the other hand, when light was high, seedlings showed an increase in root allocation to favour an increase in water uptake, and a decrease in leaf area ratio can favour a decrease in transpiration rate. [evidence from crop cultivation]
410	1958. Clayton, W.D.. Secondary Vegetation and the Transition to Savanna Near Ibadan, Nigeria. <i>The Journal of Ecology</i> . 46 (2): 217-238.	<i>Rauvolfia vomitoria</i> appears in successional vegetation on clayey, sandy and poorly drained and swampy soils in Nigeria.
410	1981. Aweto, A.O.. Succession and Soil Fertility Restoration in South-Western Nigeria: I. Succession.. <i>The Journal of Ecology</i> . 69 (2): 601-607.	"The highly weathered, intensely leached, ferrallitic tropical soils area derived from sedimentary rocks which are mainly unconsolidated sandstone. Consequently, the soils have kaolinite as their predominant clay mineral, contain little weatherable mineral reserves, have a low nutrient status and a low cation exchange capacity. "
411	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	<i>Rauvolfia vomitoria</i> is a shrub or small tree up to 8 m. [no climbing or smothering growth habit]

412	1958. Clayton, W.D.. Secondary Vegetation and the Transition to Savanna Near Ibadan, Nigeria. The Journal of Ecology. 46 (2): 217-238.	"After repeated cycles of cultivation a change may be detected in the composition of the farm regrowth and the pollarded saplings. It is not so rich in species, and many of the plants so characteristic of tall thicket such as <i>Funtumia</i> spp. Are much reduced in frequency, while others, notably <i>Rauvolfia vomitoria</i> and members of the Sapindales have become prominent. [intensive and repeated cultivation results in formation of <i>Rauvolfia</i> thickets]...Unlike the thicket it is never impenetrable, and sometimes it is quite easy to walk through [secondary forest being contrasted to <i>Rauvolfia</i> and other thickets]...The most usual vegetation at the edge of the grassland, however, is not <i>Ficus</i> fallow, but a mixture of savanna species with those of <i>Rauvolfia</i> thicket, interspersed with patches of <i>Imperata</i> ...It appears that once <i>Imperata</i> had become established, and provided the grass is regularly fired, it can invade adjacent <i>Rauvolfia</i> thicket. Otherwise the relatively dense <i>Rauvolfia</i> thicket offers few opportunities for the establishment of <i>Imperata</i> , which is intolerant of shade;"
501	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19–26.	Terrestrial tree
502	1988. Steentoft, M.. Flowering Plants in West Africa. Cambridge University Press, Cambridge, UK	Apocynaceae
503	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Nitrogen fixing: Forms root nodules with vesicular arbuscular mycorrhiza
504	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19–26.	<i>Rauvolfia vomitoria</i> is a shrub or tree 0.5–20.0 m tall [not a geophyte]
601	2007. Schmelzer, G.H.. <i>Rauvolfia vomitoria</i> Afzel. - Prota 11(1): Medicinal plants/Plantes médicinales 1. [CD-Rom].. PROTA, Wageningen, Netherlands	" <i>Rauvolfia vomitoria</i> is widely distributed throughout its distribution area, but it is possibly endangered in several countries, e.g. in Ghana, due to overharvesting." [threatened due to overharvesting, but no evidence of substantial reproductive failure in native range]
602	1989. Keay, R.W.J.. Trees of Nigeria. Clarendon Press, Oxford, UK	The fruits are one or a pair of globose or ellipsoid drupes about 12 mm in length [Genus description] Fruits (Apr.-Aug.) red, globose, about 6 mm diam. [Species description].
602	2002. Omino, E.A.. Entry for <i>Rauvolfia vomitoria</i> Afzel. Flora of Tropical East Africa. http://plants.jstor.org/flora/fta006055	Fruits bright orange or red, usually 1 mericarp developing, globose, ovoid or ellipsoid, 8–14 mm long, up to 9 mm in diameter; seeds ellipsoid, 6–8 mm long.
603	1956. Rao, A.S.. A Revision of <i>Rauvolfia</i> With Particular Reference to the American Species. Annals of the Missouri Botanical Garden. 43 (3): 253-354.	Hybridization suspected within species of genus [but ability of <i>Rauvolfia vomitoria</i> to naturally hybridize is unknown]
604	2007. Simoes, A.O./Livshultz, T./Conti, E./Endress, M. E.. Phylogeny and systematics of the Rauvolfioideae (Apocynaceae) based on molecular and morphological evidence. Annals of the Missouri Botanical Garden. 94: 268–297.	"Functional dioecy has been reported in <i>Rauvolfia sellowii</i> and functional gynodioecy in <i>R. vomitoria</i> ...In functionally dioecious and gynodioecious species of both <i>Rauvolfia</i> and <i>Carissa</i> , the female plants have normal appearing but sterile anthers, and the style is shorter than in the flowers of pollen-producing male plants. " [<i>R. vomitoria</i> suspected of being self-compatible based on observations from Hawaiian Islands]

605	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. Rauvolfia L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België. 61 (1/2): 21-69.	Inflorescence in whorls of 1-4, congested to lax many (15- ca 450)-flowered cymes; peduncle 1.5- 8.6 cm long, puberulous; pedicels 1-4.5 mm long, puberulous. Flowers sweet-scented, slightly zygomorphic; sepals pale to dark green, connate at the base for 0.2-0.3 mm, unequal, ovate, 0.5-1.3 x as long as wide, 1-2.2 x 0.9-2.1 mm, slightly auriculate, obtuse or acute at the apex, glabrous or puberulous outside, glabrous inside, ciliate or not; corolla hypocrateriform, green to white, yellow, or lobes creamy and the tube greenish, which is paler in the middle; tube 4 8 x as long as the calyx, 5.8- 10(12) mm long, glabrous outside, glabrous inside except for 3 small belts in the upper part: 1. at the beginning of the swelling of the tube, 0.1 0.8(1.3) mm wide, variably papillose; 2. just below the insertion of the stamens, 0-0.4 mm wide, puberulent; 3. 0.1-1 mm below the mouth, 0.1-0.2 mm wide, setose; lobes dolabriform, 0.1-0.3 x as long as the tube, 0.4 1 x as long as wide, 1.1-2.1 x 1.1-4 mm, glabrous; stamens inserted 4.3- 7.0(8.6) mm above the corolla base, included; filaments 0.2-0.5 x 0.1-0.2 mm, glabrous; anther 0.8 1.3 x 0.5-1 mm, apiculate or mucronate at the apex, acumen 0.1-0.2 mm; disk cupular, 0.7 2 mm high, slightly crenate; pistil (3.8)4.2 9.2 mm long; ovary composed of 2 carpels fused for 0.2-0.4 mm, 1.3-3.2 x 0.8-1.8 mm, obovate, ovoid or cylindrical; style (2)2.4-5.2 x 0.1-0.2 mm, glabrous or pubescent at the base; pistil-head 0.5- 1.2(1.7) x 0.3-1 mm; stigmoid apex 0.1 long. [no indications that flowers are adapted for specialized pollinators]
605	2007. Schmelzer, G.H.. Rauvolfia vomitoria Afzel. - Prota 11(1): Medicinal plants/Plantes médicinales 1. [CD-Rom].. PROTA, Wageningen, Netherlands	"The flowers are pollinated by insects such as small bees and flies, and the fruits are dispersed by birds."
605	2010. World Agroforestry Center. Agroforestry Tree Database - Rauvolfia vomitoria. http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Apiculture: The sweet-scented flowers are frequented by bees.
606	1996. Balick, M.J./Elisabetsky, E./Laird, S. A.. Medicinal Resources of the Tropical Forest: Biodiversity and Its Importance to Human Health. Columbia University Press, New York, NY	"Some medicinal plants, e.g., Rauvolfia vomitoria...can be exploited continuously because of their ability to regenerate themselves." [Although this species can resprout from cuttings, no evidence was found to indicate that it spreads vegetatively or by root suckering]
606	2010. World Agroforestry Center. Agroforestry Tree Database - Rauvolfia vomitoria. http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Natural stump regrowth is possible in this species.
607	1958. Piringer, A. A./Downs, R. J./Borthwick, H. A.. Effects of Photoperiods on Rauvolfia. American Journal of Botany. 45 (4): 323-326.	"Rauvolfia vomitoria is a tree species native to tropical Africa, specifically the Belgian Congo, and its maximum natural range is from 200 to 100 N latitude. Daylengths measured from sunrise to sunset at 200 latitude have an approximate seasonal range of 10.9 to 13.3 hr. The growth of plants at photoperiods experimentally shorter or longer than those within the natural range was markedly delayed or accelerated."
607	1983. Swaine, M.D./Hall., J.B.. Early Succession on Cleared Forest Land in Ghana. The Journal of Ecology. 71(2): 601-627.	"...very early reproduction was recorded...in Rauvolfia vomitoria (flowers at 2 years on a 2 m tall tree)..."
607	2005. Waltert, M./Bobo, K.S./Sainge, N.M./Fermon, H./Hlenberg, M.M.. From forest to farmland: habitat effects on Afrotropical bird diversity. Ecological Applications. 15(4): 1351-1366.	While the most often recorded trees in near-primary forests were regenerating trees and shrubs characteristic of mature rain forest "(Oubanguia alata, Gilbertiodendron demonstrans), secondary forests were dominated by oil palms (Elaeis guineensis, which, at least partly, indicate agricultural activities) or by gap species and other fast growing pioneers such as Pycnanthus, Rauvolfia, or Musanga spp." [describes R. vomitoria as "fast-growing"]
701	1989. Keay, R.W.J.. Trees of Nigeria. Clarendon Press, Oxford, UK	The fruits are one or a pair of globose or ellipsoid drupes about 12 mm in length [Genus description] Fruits (Apr.-Aug.) red, globose, about 6 mm diam. [Species description]. [No evidence, and no means of external attachment]
702	2010. World Agroforestry Center. Agroforestry Tree Database - Rauvolfia vomitoria. http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	"Ornamental: Widely planted as an ornamental and avenue tree"
703	1989. Keay, R.W.J.. Trees of Nigeria. Clarendon Press, Oxford, UK	The fruits are one or a pair of globose or ellipsoid drupes about 12 mm in length [Genus description] Fruits (Apr.-Aug.) red, globose, about 6 mm diam. [Species description]. [No evidence of produce contamination, and unlikely given relatively large fruit]

703	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. Rauvolfia L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België. 61 (1/2): 21-69.	Fruits orange or red, usually 1 mericarp developing, globose (up to 8 mm diam.), ovoid or ellipsoid (8-14 x 6-9 mm). Seeds ellipsoid, 6-8 x 3-6 x 1.5-4 mm. [Fruits and seeds fairly large, with no evidence that they contaminate produce]
704	1989. Keay, R.W.J.. Trees of Nigeria. Clarendon Press, Oxford, UK	The fruits are one or a pair of globose or ellipsoid drupes about 12 mm in length [Genus description] Fruits (Apr.-Aug.) red, globose, about 6 mm diam. [Species description] [no adaptations for wind dispersal]
705	1956. Rao, A.S.. A Revision of Rauvolfia With Particular Reference to the American Species. Annals of the Missouri Botanical Garden. 43 (3): 253-354.	Many species, not only in America but also in Africa and Asia, have a distribution following rivers and streams. The stones of Rauvolfia are hard and can withstand considerable buffeting in water currents. It may well be that birds and water currents together are responsible for the wide dispersal of the genus.
705	1998. Friis, I./Vollesen, K./Danske, K.. Flora of the Sudan-Uganda Border Area East of the Nile: catalogue of vascular plants. Kgl. Danske Videnskabernes Selskab, Denmark	R. vomitoria...banks of seasonal river...in riverine vegetation [distribution suggests that seeds may be moved by water]
705	2003. Natta, A.K.. Ecological assessment of riparian forests in Benin: Phytodiversity, phytosociology, and spatial distribution of tree species. PhD Dissertation.. Wageningen University, Netherlands	List of riparian forests plant species of Benin [includes R. vomitoria]
706	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. Rauvolfia L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België. 61 (1/2): 21-69.	Fruits orange or red, usually 1 mericarp developing, globose (up to 8 mm diam.), ovoid or ellipsoid (8-14 x 6-9 mm). Seeds ellipsoid, 6-8 x 3-6 x 1.5-4 mm. [fleshy-fruited & adapted for bird dispersal]
706	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19-26.	"The bright red fruit have been noted locally being consumed by mynah birds; in its home range, the seeds are bird-dispersed."
706	2010. World Agroforestry Center. Agroforestry Tree Database - Rauvolfia vomitoria. http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	R. vomitoria is a hermaphroditic species. Fruit dispersal is by birds.
707	1991. van Dilst, F. J. H./Leeuwenberg, A. J. M.. Rauvolfia L. in Africa and Madagascar Series of Revisions of Apocynaceae XXXIII. Bulletin du Jardin botanique national de Belgique / Bulletin van de National Plantentuin van België. 61 (1/2): 21-69.	Fruits orange or red, usually 1 mericarp developing, globose (up to 8 mm diam.), ovoid or ellipsoid (8-14 x 6-9 mm). Seeds ellipsoid, 6-8 x 3-6 x 1.5-4 mm [fruits & seeds without any means of external attachment]
708	2001. Poulsen, J.R./Clark, C. J./Smith, T.B.. Seed Dispersal by a Diurnal Primate Community in the Dja Reserve, Cameroon. Journal of Tropical Ecology. 17(6): 787-808.	List of seeds dispersed by primates in the Dja Reserve, Cameroon...The unknown column represents the assemblage of arboreal monkeys, and the data are derived from faeces deposited in seed traps and faeces found opportunistically on the forest floor. [includes R. vomitoria]
708	2010. World Agroforestry Center. Agroforestry Tree Database - Rauvolfia vomitoria. http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Fruits are fleshy and red in colour...Fruit dispersal is by birds [fruits presumably survive passage through GI tract of birds]
801	2010. WRA Specialist. Personal Communication.	Unknown whether trees can produce seed densities of >1000/m2
802	2007. Schmelzer, G.H.. Rauvolfia vomitoria Afzel. - Prota 11(1): Medicinal plants/Plantes médicinales 1. [CD-Rom].. PROTA, Wageningen, Netherlands	"The seeds lose their viability quickly, and need to be sown within 6 months after ripening."
802	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19-26.	"The seeds appear to germinate quickly, but seed longevity is unknown."

803	2009. Leary, J.. Case Studies: A Case Study in Rapid Response: <i>Rauvolfia vomitoria</i> . University of Hawai'i - College of Tropical Agriculture and Human Resources, http://www.ctahr.hawaii.edu/LearyJ/videos/case-study-rauwolfia.html	Dr. James Leary, CTAHR Invasive Weed Specialist, observes the results of herbicide field trials to control a <i>Rauvolfia vomitoria</i> infestation on Hawaii Island 100 days later. This video describes the pros and cons of each treatment (broadcast application/spraying, frill and squirt) using triclopyr, imazapyr, and glyphosate. [After 100 days, preliminary results suggest foliar application of triclopyr may not be very effective; foliar application of imazapyr creates necrotic apical tips & necrotic lesions & chlorosis on leaves, & may still be affecting treated plants, but also kills pasture grass; foliar application of glyphosate appears very effective; results of frill cut treatments for each herbicide are similar]
804	2007. Schmelzer, G.H.. <i>Rauvolfia vomitoria</i> Afzel. - Prota 11(1): Medicinal plants/Plantes médicinales 1. [CD-Rom].. PROTA, Wageningen, Netherlands	" <i>Rauvolfia vomitoria</i> can be coppiced or pollarded."
804	2010. Kennedy, B.H./James, S.A./Imada, C.T.. New Hawaiian plant records from Herbarium Pacificum for 2008. Bishop Museum Occasional Papers. 107: 19–26.	"This fast-growing tree responds vigorously to cutting, with numerous new stems arising from the cut stump. After mowing, resprouts reach a height of 1.0–1.25 m within 2 months."
804	2010. World Agroforestry Center. Agroforestry Tree Database - <i>Rauvolfia vomitoria</i> . http://www.worldagroforestry.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=1768	Natural stump regrowth is possible in this species...Roots for medicinal use may be harvested non-destructively annually by cutting them 10 cm from the taproot.
805	2010. WRA Specialist. Personal Communication.	No introduced biocontrol agents known, and prolific and apparently rapid spread on the island of Hawaii suggests that no effective natural enemies are present