

Taxon: Paullinia cupana Kunth	Family: Sapindaceae
Common Name(s): Brazilian cocoa guaraná	Synonym(s): Paullinia sorbilis Mart.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 13 Apr 2016
WRA Score: -7.0	Designation: L	Rating: Low Risk

Keywords: Tropical Liana, Domesticated, Commercial Uses, Bird-Dispersed, Recalcitrant Seeds

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	y
102	Has the species become naturalized where grown?	y=1, n=-1	n
103	Does the species have weedy races?	y=1, n=-1	n
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	n
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	n
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
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		
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		
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
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

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	y
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		
604	Self-compatible or apomictic	y=1, n=-1	n
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		
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	n
801	Prolific seed production (>1000/m ²)		
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	y
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). Neglected Crops: 1492 from a Different Perspective. FAO, Rome, Italy	"The var. sorbilis, or true guarana, seems to have been domesticated in the southern strip of the Amazon River between the gorges of the Purús and Madeira Rivers." ... "The geographical disjunction between the two varieties has been attributed to anthropic factors; according to this hypothesis, the species was domesticated in the Maués region from a woody liana which reaches the forest canopy. Both the plant and the way of eating it were introduced to the upper Negro River area by the Barrés (or Barés), who gradually migrated north. Domestication of the species must have been very old to enable the formation of a new variety."
	Erickson, H. T., Correa, M. P. F., & Ricardo Escobar, J. (1984). Guaraná (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	[A shrub in cultivation] "Guarana, <i>Paullinia cupana</i> Kunth ex H.B.K., is in the Sapindaceae. The cultivated form is often referred to as <i>Paullinia cupana</i> variety <i>sorbilis</i> Ducke. Several species of <i>Paullinia</i> are found in the Amazon Basin and much remains to be resolved concerning the taxonomy of the genus. In the primeval Amazonian forest <i>P. cupana</i> is a liana, its woody stems, supported by towering tree trunks, reach high into the forest canopy. Under cultivation, however, it becomes a sprawling shrub growing perhaps 2 m tall with a diameter twice as great (Fig. 2)."

102	Has the species become naturalized where grown?	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

103	Does the species have weedy races?	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

Qsn #	Question	Answer
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
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"The species is indigenous to the Amazon basin. The var. cupalla is found in the area between the south of the Atures and Maipures torrents of the Orinoco River and in the region of the upper Negro River and tributaries on the frontiers between Brazil, Colombia and Venezuela, where it seems to be relatively common (Lleras 1994). The var. sorbilis or true guarana, seems to have been domesticated in the southern strip of the Amazon River between the gorges of the Purus and Madeira Rivers."

202	Quality of climate match data	High
	Source(s)	Notes
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). Neglected Crops: 1492 from a Different Perspective. FAO, Rome, Italy	"The soils in which it is found in the native state are generally gley soils or dystrophic lateritic soils. The climate of the region of origin is Am in Köppen's classification, with an annual precipitation of approximately 2 200 to 2 500 mm. The temperature is isothermal, with an annual mean of 28 to 29°C." ... "According to technical recommendations, guarana must be grown in areas with a climate similar to its region of origin, with a mean annual temperature between 22 and 20°C. The minimum temperature tolerated is 12°C. Annual precipitation must exceed 1 400 mm, with rain well distributed during the year."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 12 Apr 2016]	""Native: Southern America Brazil: Brazil Northern South America: Venezuela Western South America: Peru - Loreto"

205	Does the species have a history of repeated introductions outside its natural range?	n
	Source(s)	Notes

Qsn #	Question	Answer
	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 13 Apr 2016]	"Native: Brazil, Colombia, Uruguay, Venezuela Exotic: Argentina, Mexico, United States of America"
	Imada, C.T., Staples, G.W. & Herbst, D.R. 2005. Annotated Checklist of Cultivated Plants of Hawai'i. http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/ . [Accessed 13 Apr 2016]	" <i>Paullinia cupana</i> Kunth Common Names: Guarana Locations: Waimea Arboretum & Botanical Garden"

301	Naturalized beyond native range	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence
	Wagner, W.L., Herbst, D.R. & Lorence, D.H. 2016. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/index.htm . [Accessed 13 Apr 2016]	No evidence

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

Qsn #	Question	Answer
305	Congeneric weed	
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	Four <i>Paullinia</i> species have been included in unpublished weed lists, but impacts are unspecified

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	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 12 Apr 2016]	[No evidence] " <i>Paullinia cupana</i> is a scandent shrub or woody liana. Leaves compound alternate with five folioles and, when tendrils exist, they are axillary."

402	Allelopathic	
	Source(s)	Notes
	WRA Specialist. 2016. Personal Communication	Unknown

403	Parasitic	n
	Source(s)	Notes
	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 12 Apr 2016]	" <i>Paullinia cupana</i> is a scandent shrub or woody liana." [Sapindaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Baumann, T. W., Schulthess, B. H., & Hänni, K. (1995). Guarana (<i>Paullinia cupana</i>) rewards seed dispersers without intoxicating them by caffeine. <i>Phytochemistry</i> , 39 (5), 1063-1070	[Ariels palatable. Palatability of foliage unknown] "As mentioned above, large birds native to the Upper Amazon [13-1, such as toucans or guans, are known to forage on and disperse the arillate seeds of the guarana liana [10]."

405	Toxic to animals	n
	Source(s)	Notes

Qsn #	Question	Answer
	Mattei, R., Dias, R. F., Espinola, E. B., Carlini, E. A., & Barros, S. B. M. (1998). Guarana (<i>Paullinia cupana</i>): toxic behavioral effects in laboratory animals and antioxidant activity in vitro. <i>Journal of Ethnopharmacology</i> , 60(2), 111-116	[No evidence in this study] "The effects on toxic and behavioral levels of guarana (<i>Paullinia cupana</i>) were assessed in rats and mice subsequent to acute and chronic administrations and were compared to those produced by Ginseng (<i>Panax ginseng</i>). Experimental parameters included tests for antioxidant capacity in vitro and measured in vivo, toxicological screening, progress in weight, motor activity, death rate, and histopathological examination of the viscera. Guarana showed an antioxidant effect because, even at low concentrations (1.2 mg:ml), it inhibited the process of lipid peroxidation. In high doses of 1000-2000 mg:kg (i.p. and p.o.) it did not induce significant alterations in parameters for toxicological screening. No effects on motor activity were observed, neither did guarana alter the hypnotic effect of pentobarbital. Ginseng (250-1000 mg:kg i.p.), however, elicited reductions in motor activity, eyelid ptosis and bristling fur. Consumption of liquids containing guarana or ginseng and progress in weight of the animals remained at levels similar to the controls, even after prolonged administration. The percentage mortality was equivalent in control and in treated groups. The absence of toxicity of guarana was also demonstrated by histopathological examination, with no alteration being detected in heart, lungs, stomach, small and large intestine, liver, pancreas, kidneys, bladder and spleen."
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . http://www.worldagroforestry.org . [Accessed 13 Apr 2016]	" <i>Meloidogyne arenaria</i> and <i>M. thamesi</i> cause wrinkles and fissures on the juncture between the roots and the stem of seedlings of the guarana tree. <i>Fusarium decemcellulare</i> , imperfect state of <i>Calonectria rigidiuscula</i> , causes swelling of the collar leading to death. <i>Xiphinema americanum</i> is the commonest parasitic nematode in nurseries of <i>P. cupana</i> and <i>Xiphinema</i> sp. On mature species."
	Janick, J. & Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts</i> . CABI Publishing, Wallingford, UK	"The most severe disease is anthracnose caused by the fungus <i>Colletotrichum guaranicola</i> which attacks both foliage and flowers. Severity varies from year to year but it is present in all plantations. Individual plants differ in susceptibility and this has led to a programme to develop resistant or tolerant cultivars. A disease caused by <i>Fusarium decemcellulare</i> causes a proliferation of buds resulting in masses of tumour-like growths. "

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	" <i>Paullinia cupana</i> " ... "(Seeds stimulant, tonic, nervine, astringent, aphrodisiac, antipyretic, antineuralgic, anti-diarrheal, used in the treatment of headache and neuralgia, menstrual disorders. Ritual and medicinal purposes.)"

Qsn #	Question	Answer
	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 13 Apr 2016]	[No evidence] "Food: Guarana is used mainly to produce soft drinks. Seeds contain 2.7-5.8 % caffeine as well as theophylline and theobromine. Seeds are roasted and their seed coat removed; this is marketed as guarana en rama (raw guarana). Seeds are usually immersed in water to form a paste. From this are made sticks, which, after being dried over a slow fire and smoked for one month, are marketed. The traditional way of preparing the drink consists of grating part of the stick in water to produce an infusion. The guarana carbonated drinks industry began in 1907 and the product became Brazil's national drink during the 1940s. Nowadays, guarana is marketed as sticks and soluble or insoluble powder and is used industrially for the production of carbonated drinks, syrups and herbalists' products. Essential oil: The essential oil isolated from powdered seeds of guarana has 9 identifiable constituents: 2 methylbenzenes, a cyclic monoterpene, 2 cyclic sesquiterpene hydrocarbons, 2 methoxyphenylpropenes and 2 alkylphenol derivatives. Medicine: Guarana is attributed antipyretic, antineuralgic and antidiarrhoeal properties and is reputed to be a powerful stimulant, an analgesic comparable to aspirin and an anti-influenza agent. The Rainforest tribes have used guarana mainly as a stimulant, astringent and in treating chronic diarrhoea. Other products: Guaraná contains a high amount of guaranine (thein, caffeine, methyltheobromine, No-Doz (chemical name; 3,7-Dihydro-1,3,7-trimethyl-1H-purine-2,6-dione {C8H10N4O2}) a chemical substance with the same characteristics as caffeine. The seed kernel and the seed coat have high concentrations of alkaloids, particularly caffeine (4.28 and 1.64% dry weight basis, respectively); the aril is alkaloid-free, but contains glucose, fructose and sucrose (68.5% dry weight basis). Tannic acid, catechutannic acid starch, and a greenish fixed oil have also been isolated from seeds."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	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 13 Apr 2016]	[No evidence. Unlikely given wet habitat] "Annual precipitation must exceed 1400 mm, with rain well distributed during the year."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). Neglected Crops: 1492 from a Different Perspective. FAO, Rome, Italy	[Grown in full sun] "Traditional cultivation of guarana is carried out with full exposure to sun on soils with a low fertility (exchange capacity of 20 to 40 ppm), a low acidity (pH between 3.5 and 4.5) and with high concentrations of aluminium."
	Erickson, H. T., Correa, M. P. F., & Ricardo Escobar, J. (1984). Guaraná (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	[Grown in heavy shade] "As seedlings emerge they are planted in soil-filled, 1-liter containers made of black plastic film (Fig. 9). They are kept under heavy shade for nearly a year before field planting, in January and February, at the height of the rainy season."

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). Guaraná (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	"A common observation in guarana plantings is that they are intolerant of soil compaction. Plantations prepared by bulldozing trees and brush fail to grow as well as those cleared by felling and burning the trees, without the use of ground compacting machinery. The difference persists and cannot be accounted for by the fertilizer benefits of the ash. The severe effect of compaction on these red-yellow oxisols is easily observed by the poor root penetration of annual crops on soils that have been subjected even slightly to mechanized equipment."
	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 13 Apr 2016]	"Soil type: The soils in the natural habitat are generally gley or dystrophic lateritic soils with low pH (3.5-4.5)."
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	"Soils must be deep, medium or heavy in texture, well drained and with a high organic matter content."

411	Climbing or smothering growth habit	y
	Source(s)	Notes
	Lim, T.K. 2013. <i>Edible Medicinal And Non-Medicinal Plants</i> . Volume 6, Fruits. Springer, Dordrecht	"Guarana is a scandent shrub or woody evergreen liana with arching woody, longitudinally-furrowed stem climbing up tree trunks for support reaching high into the forest canopy but under cultivation growing to 2 m high."

412	Forms dense thickets	n
	Source(s)	Notes
	Lim, T.K. 2013. <i>Edible Medicinal And Non-Medicinal Plants</i> . Volume 6, Fruits. Springer, Dordrecht	[Climbing] "Guarana is a scandent shrub or woody evergreen liana with arching woody, longitudinally furrowed stem climbing up tree trunks for support reaching high into the forest canopy but under cultivation growing to 2 m high."

501	Aquatic	n
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). Guaraná (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	[Terrestrial liana or shrub] "In the primeval Amazonian forest <i>P. cupana</i> is a liana, its woody stems, supported by towering tree trunks, reach high into the forest canopy. Under cultivation, however, it becomes a sprawling shrub growing perhaps 2 m tall with a diameter twice as great"

502	Grass	n
	Source(s)	Notes

Qsn #	Question	Answer
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 12 Apr 2016]	"Family: Sapindaceae Subfamily: Sapindoideae"
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 12 Apr 2016]	"Family: Sapindaceae Subfamily: Sapindoideae"
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). Guaraná (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	"In the primeval Amazonian forest <i>P. cupana</i> is a liana, its woody stems, supported by towering tree trunks, reach high into the forest canopy. Under cultivation, however, it becomes a sprawling shrub growing perhaps 2 m tall with a diameter twice as great"
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Lim, T.K. 2013. <i>Edible Medicinal And Non-Medicinal Plants</i> . Volume 6, Fruits. Springer, Dordrecht	[No evidence] "The species is indigenous to the Amazon basin. The var. <i>cupalla</i> is found in the area between the south of the Atures and Maipures torrents of the Orinoco River and in the region of the upper Negro River and tributaries on the frontiers between Brazil, Colombia and Venezuela, where it seems to be relatively common (Lleras 1994)."
602	Produces viable seed	y
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). Guaraná (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	"A single inflorescence often bears several dozen fruits in different stages of maturity because of the protracted flowering habit (Fig. 7). Seeds are composed of 2 fleshy cotyledons surrounded by a thin, woody coat. The embryo is immature at the time of fruit ripening. Germination is hypogeous and requires 1-3 mo. Seeds lose viability rapidly if permitted to dry out."
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . http://www.worldagroforestry.org . [Accessed 13 Apr 2016]	"Seeds are recalcitrant and lose their viability in 72 hours under normal conditions. Germination can take more than 100 days."
603	Hybridizes naturally	

Qsn #	Question	Answer
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	[Unknown if natural hybrids occur] "The production of hybrids, either through traditional methods or using genetic engineering techniques, will also be of great importance, especially in conjunction with the production of clonal material which allows more uniform treatment and management to be achieved."
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). <i>Guaraná (Paullinia cupana) as a commercial crop in Brazilian Amazonia</i> . <i>Economic Botany</i> , 38(3), 273-286	No evidence

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	"Guarana is a monoecious, allogamous species." [reproducing by cross-fertilization]

605	Requires specialist pollinators	n
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). <i>Guaraná (Paullinia cupana) as a commercial crop in Brazilian Amazonia</i> . <i>Economic Botany</i> , 38(3), 273-286	"Flowers open in early morning. Most pollen has disappeared by midday. Pistillate flowers seem to be receptive for one day only. Pollination is by insects, primarily bees and wasps. Ants are numerous on all plants, with large numbers continually moving about the branches and leaves. Some pollen might be distributed by them as well."
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	"It is fertilized by bees of the genera <i>Melipona</i> and <i>Apis</i> ."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Janick, J. & Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts</i> . CABI Publishing, Wallingford, UK	[No evidence of natural vegetative spread] "In Brazil, plants are nursery grown from seeds that have been stratified in moist sawdust." ... "Clonal propagation is sometimes used...Elite plants may be propagated by cuttings or tissue culture and subsequently field planted when well established, as with seedlings."

607	Minimum generative time (years)	2
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & ricardo Escobar, J. (1984). <i>Guaraná (Paullinia cupana) as a commercial crop in Brazilian Amazonia</i> . <i>Economic Botany</i> , 38(3), 273-286	"The juvenile stage persists about 1 yr. Some plants flower when 1 1/2 yr old, but 3-4 yr are required for commercially significant production."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	"The fruit occurs in a septicidal capsule, it is orangey-red and partially open when ripe, revealing one to three black or greenish seeds which are covered at the base with a white aril. The var. <i>cupana</i> differs from the var. <i>sorbilis</i> in that it has no tendrils, its folioles are more strongly lobed and its flowers and fruit are bigger." [No evidence. Fruits & seeds lack means of external attachment]
702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Fruit Lover's Seed Co. 2016. Tropical Fruit Seed List. http://www.fruitlovers.com/seedlistUSA.html . [Accessed 13 Apr 2016]	Seeds sold online
703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Bewley, J. D., Black, M. & Halmer, P. (2006). <i>The Encyclopedia of Seeds: Science, Technology and Uses</i> . CABI, Wallingford, UK	"The ovoid or pear-shaped fruits, about the size of a grape and red when ripe, contain 1- 3 seeds. Each seed is sub-spherical, about 1 cm in diameter with a shiny, red- brown testa, covered by a pale brown-white, cupular aril) at the base" [No evidence. Unlikely. Fruits & seeds are relatively large & unlikely to become a produce contaminant]
704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	"The fruit occurs in a septicidal capsule, it is orangey-red and partially open when ripe, revealing one to three black or greenish seeds which are covered at the base with a white aril." ... "It is probably dispersed naturally by birds, although the distances to which it can be disseminated are not known."
705	Propagules water dispersed	
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). <i>Neglected Crops: 1492 from a Different Perspective</i> . FAO, Rome, Italy	"The var. <i>sorbilis</i> , or true guarana, seems to have been domesticated in the southern strip of the Amazon River between the gorges of the Purus and Madeira Rivers." [Adapted for bird dispersal, but proximity to rivers may allow for some dispersal by water]
706	Propagules bird dispersed	y
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R. & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . http://www.worldagroforestry.org . [Accessed 12 Apr 2016]	"Fruit pear shaped, orange-red, and 3 sided with three-celled capsules, partially open when ripe, revealing 1-3 black or greenish seeds which are covered at the base with a white aril." ... "It is dispersed by birds."

Qsn #	Question	Answer
	Baumann, T. W., Schulthess, B. H., & Hänni, K. (1995). Guarana (<i>Paullinia cupana</i>) rewards seed dispersers without intoxicating them by caffeine. <i>Phytochemistry</i> , 39 (5), 1063-1070	"The fruit of the Amazonian guaranfi liana (<i>Paullinia cupana</i>) looks like a human eye, and undoubtedly shows the 'bird dispersal syndrome'. The seeds were reported to be ingested by large birds such as toucans and guans. We determined the purine alkaloid content of the various fruit and seed parts."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Baumann, T. W., Schulthess, B. H., & Hänni, K. (1995). Guarana (<i>Paullinia cupana</i>) rewards seed dispersers without intoxicating them by caffeine. <i>Phytochemistry</i> , 39 (5), 1063-1070	[Internally dispersed] "large birds such as toucans (<i>Ramphastos</i> spp.) and guans (<i>Penelope</i> spp.) have been reported to gulp guarana seeds [1(3) which they may regurgitate after having digested the arils."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	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 13 Apr 2016]	"Fruit pear shaped, orange-red, and 3 sided with three-celled capsules, partially open when ripe, revealing 1-3 black or greenish seeds which are covered at the base with a white aril." ... "It is dispersed by birds." [Presumably Yes]

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Bewley, J. D., Black, M. & Halmer, P. (2006). <i>The Encyclopedia of Seeds: Science, Technology and Uses</i> . CABI, Wallingford, UK	"The ovoid or pear-shaped fruits, about the size of a grape and red when ripe, contain 1- 3 seeds. Each seed is sub-spherical, about 1 cm in diameter with a shiny, red- brown testa, covered by a pale brown-white, cupular aril) at the base" [Seed densities unknown. Unlikely given large size]

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	Erickson, H. T., Correa, M. P. F., & Ricardo Escobar, J. (1984). Guarana (<i>Paullinia cupana</i>) as a commercial crop in Brazilian Amazonia. <i>Economic Botany</i> , 38(3), 273-286	"Germination is hypogeous and requires 1-3 mo. Seeds lose viability rapidly if permitted to dry out."
	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 13 Apr 2016]	"Seeds are recalcitrant and lose their viability in 72 hours under normal conditions. Germination can take more than 100 days."

Qsn #	Question	Answer
803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. 2016. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species
804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Hernando Bermejo, J.E. & Leon, J. (eds.). (1994). Neglected Crops: 1492 from a Different Perspective. FAO, Rome, Italy	[Tolerates some pruning] "After the second year, pruning is carried out to remove old and diseased branches and those which 1lowered the previous year."
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2016. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates
- Shade tolerant
- Reproduces by seeds
- Can reach reproductive maturity in 18 months
- Seeds dispersed by birds & intentionally by people

Low Risk Traits

- Domesticated in South America
- No reports of invasiveness or naturalization, but no evidence of widespread introduction outside native range
- Unarmed (no spines, thorns or burrs)
- Seeds used commercially for beverages
- Allogamous (reproduces by cross-pollination)
- Not reported to spread vegetatively
- Seeds are recalcitrant & lose their viability in 72 hours under normal conditions