Taxon: Paubrasilia echinata (Lam.) Gagnon et al. **Family:** Fabaceae

Common Name(s): Brazilwood
ibirapitanga
palo brasil
palo de pernambuco
peachwood
pernambuco wood

Synonym(s): Caesalpinia echinata Lam.
Guilandina echinata (Lam.) Spreng.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 5 May 2022

WRA Score: -6.0 **Designation:** L **Rating:** Low Risk

Keywords: Tropical Tree, Hardwood, Armed, Self-Incompatible, Autochorous

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	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	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	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	y
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals		
405	Toxic to animals		
406	Host for recognized pests and pathogens		

Qsn #	Question	Answer Option	Answer
407	Causes allergies or is otherwise toxic to humans		
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	n
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	n
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation		
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides		
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?**	**n**
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	[No evidence. Cultivated, but not domesticated] "Geographic distribution. A monospecific genus endemic to Eastern Brazil, in the states of Pernambuco, Bahia, Espirito Santo and Rio de Janeiro. Widely cultivated in Brazil as an ornamental street or park tree, and sometimes in plantations."

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2022). 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**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Caesalpinia echinata Lam., popularly known as brazilwood or pernambuco, is a tree with considerable historical and economic value that is native to the Brazilian Atlantic forest (Lewis, 1998; Lorenzi, 2002)."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 4 May 2022]	"Native Southern America BRAZIL: Brazil [Alagoas, Bahia, Espírito Santo, Paraíba, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Santa Catarina] Cultivated Southern America CARIBBEAN: Cuba BRAZIL: Brazil"

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 4 May 2022]	

203	**Broad climate suitability (environmental versatility)**	**n**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Climatic amplitude (estimates) - Altitude range: 0 - 800 m - Mean annual rainfall: 1000 - 2400 mm - Rainfall regime: summer - Dry season duration: 0 - 3 months - Mean annual temperature: 22 - 27ºC - Mean maximum temperature of hottest month: 25 - 28ºC - Mean minimum temperature of coldest month: 20 - 25ºC - Absolute minimum temperature: > -1ºC"

204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Geographic distribution. A monospecific genus endemic to Eastern Brazil, in the states of Pernambuco, Bahia, Espirito Santo and Rio de Janeiro. Widely cultivated in Brazil as an ornamental street or park tree, and sometimes in plantations."
	Imada, C. (2019). Hawaiian Naturalized Vascular Plants Checklist (February 2019 update). Bishop Museum Technical Report 69. Bishop Museum, Honolulu, HI	No evidence

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"C. echinata is widely cultivated and used in landscape design and urban arborization because of its ornamental appearance."

301	**Naturalized beyond native range**	**n**
	Source(s)	**Notes**
	Horowitz, C., Martins, C. R., & Walter, B. M. T. (2013). Flora exótica no Parque Nacional de Brasília: levantamento e classificação das espécies. Biodiversidade Brasileira-BioBrasil, (2), 50-73	"Anexo 1 – Alien species list of Parque Nacional de Brasília by family, scientific name, colonization type, occurrence in the park zone, classification in the process of biological invasion, habit and usage - in March 2013" [Caesalpinea echinata is classified as "Casual B" which is defined in this paper as "Species classified as casual exotic with low (B) establishment propensity and population growth and as a persistent exotic with a low potential risk of invasion"]

Qsn #	Question	Answer
	Imada, C. (2019). Hawaiian Naturalized Vascular Plants Checklist (February 2019 update). Bishop Museum Technical Report 69. Bishop Museum, Honolulu, HI	No evidence
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence. Listed as a "Casual Alien" outside natural distribution in The Parque Nacional de Brasília

302	Garden/amenity/disturbance weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	No evidence

304	Environmental weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	No evidence

305	Congeneric weed	y
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	[No evidence] "Geographic distribution. A monospecifi c genus endemic to Eastern Brazil, in the states of Pernambuco, Bahia, Espirito Santo and Rio de Janeiro. Widely cultivated in Brazil as an ornamental street or park tree, and sometimes in plantations."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

401	Produces spines, thorns or burrs	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	[Prickles on branches, and spiny fruit] "Description. Medium sized to large trees, 5–15+ m tall, armed with small to large upturned prickles, these usually arising from woody protuberances, 1–20 mm long (the prickles often sparse or lacking on more mature specimens and larger, older branches); bark chestnut brown to almost black with greyish pustular lenticels, flaking in large woody plates; heartwood red, with the trunk exuding a red sap when injured." ... "Fruit a spiny, finely pubescent, sub-lunate, woody,5.5–7.3 × 1.9–2.6 cm, elastically dehiscent pod with twisting valves, 1–2-seeded."

402	Allelopathic	
	Source(s)	**Notes**
	da Paz, W. P. S., Machado, M. A. B. L. & Albuquerque, K. A. D.(2020). Allelopathy of aqueous extracts of Paubrasilia echinata (Lam.) Gagnon and HC Lima and GP Lewis in lettuce seed germination. Revista Ambientale, 12(4), 8-18	[Potentially. Extracts allelopathic in controlled germination experiments] "Abstract - Brazilwood is an endangered native species with potential for use in reforestation programs, however, there is little information about its allelopathic effect on the germination of seeds of other species. Thus, the objective of this work was to evaluate the allelopathic effect of aqueous extracts of Paubrasilia echinata L. on the germination of lettuce seeds, aiming at their use in reforestation programs. Samples of fresh and dried leaves were crushed in a blender, subsequently adding 400 mL of distilled water and, after 10 minutes, the solutions were filtered. From these crude extracts, dilutions were made in distilled water and the following treatments were obtained: 0%, 25%, 50%, 75% and 100% of the fresh and dried leaf extracts. The germination test of lettuce seeds embedded in the extracts was carried out, following the recommendations of the Rules for Seed Analysis (RAS). The daily count was made, evaluating the germination speed index the germination speed and the germination percentage, considering the seeds with germination. 2 mm radicle length. Statistical analyzes were performed using the GRAPHPAD PRISM program. It was concluded that P. echinata has an allelopathic effect on the germination of lettuce seeds. The use of P. echinata in reforestation programs must be judicious, with the adoption of measures that minimize allelopathy in surrounding plants."

403	Parasitic	n
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Medium sized to large trees, 5–15+ m tall" [Fabaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**

Qsn #	Question	Answer
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Unknown. Fodder not listed among uses] "Products 1. Wood Descriptors: fuelwood; round wood; posts; piles; pit props; sawn or hewn building timbers; for heavy construction,; beams; for light construction; carpentry/joinery; flooring; wall panelling; engineering structures; hydraulic works; railway sleepers; woodware; musical instruments; turnery; furniture; veneers; boats; pulp; short fibre pulp 2. Non-wood Descriptors: dyestuffs"

405	Toxic to animals	
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[No evidence. Unlikely wood dust would impact animals] "Wood dust from this tree was reported to cause an occupational disease in the manufacture of bows for string instruments. The inhalation of this wood dust causes characteristic symptoms of the so-called 'bow-makers disease', which are dyspnoea, coughing, sneezing, crying and coryza (Hausen and Herrmann, 1990)."
	Plants for a Future. (2022). Caesalpinia echinata. https://pfaf.org. [Accessed 5 May 2022]	[No mention of toxicity to animals] "Known Hazards: Plant has spines or sharp edges; use extreme caution when handling"
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	Wylie, F. R., & Speight, M. R. (2012). Insect Pests in Tropical Forestry, 2nd Edition. CABI, Wallingford, UK	"In South America, Megaplatypus mutatus, often referred to in the literature as P. mutatus or P. sulcatus, is a serious problem in commercial plantations of a number of broadleaf tree species. It is native to tropical and subtropical areas of South America and occurs in Argentina, Bolivia, Brazil, French Guiana, Paraguay, Peru, Uruguay and Venezuela. It attacks only living, standing trees and its hosts include Acacia, Casuarina, Cedrela and Eucalyptus, but it is particularly damaging to poplars, Populus deltoides, in Argentina (Alfaro et al., 2007). Tunnelling by M. mutatus degrades the lumber and weakens the tree stems, which often then break during windstorms. Infestation by M. mutatus has been recorded in an experimental plantation of brazilwood, Caesalpinia echinata, in Brazil. Although the infestation was low level, it is nevertheless of concern because C. echinata is at risk of extinction due to exploitation and deforestation, and the wood of this species is highly valued for the manufacture of violin bows (Girardi et al., 2006)."

Qsn #	Question	Answer
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Pests recorded Insects: Atta (leaf-cutter ant) Fungus diseases: Ganoderma Pestalotiopsis maculans Pests recorded at the generic level (Caesalpinia): Insects: Coccus hesperidum (brown soft scale) Icerya purchasi (cottony cushion scale) Maruca vitrata (lima bean pod borer) Stator limbatus Fungus diseases: Armillaria tabescens (armillaria root rot)"

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Wood dust potentially harmful] "Wood dust from this tree was reported to cause an occupational disease in the manufacture of bows for string instruments. The inhalation of this wood dust causes characteristic symptoms of the so-called 'bow-makers disease', which are dyspnoea, coughing, sneezing, crying and coryza (Hausen and Herrmann, 1990)."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Soares, R. V. (1990). Fire in some tropical and subtropical South American vegetation types: an overview. Fire in the Tropical Biota, 63-81. Springer-Verlag, Berlin Heidelberg	[No evidence from native range] "The coastal rain or Atlantic forest follows almost all of the eastern coast of Brazil, from the State of Rio Grande do Sul in the south, to the State of Rio Grande do Norte in the northeast. The structure of this forest is similar to the Amazonian forest, with several species common to both." ... "Forest fires have occurred periodically in the Atlantic forest, from fires used for burning agricultural residues, pasture improvement, and cleaning sugar plantations before harvesting. However, there is no evidence of fire occurrence in this forest type in the past. The environment was quite wet, and probably fire was not part of the natural ecosystem."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Cuzzuol, G. R. F., dos Santos Galvão, E. K., Werner, E. T., Pezzopane, J. E. M., & da Silva Gasparini, X. S. (2022). Carbon reservoirs in shade-tolerant morphotype of Paubrasilia echinata are more susceptible to humidity and temperature changes than sun-tolerant morphotype. Flora, 287, 151991	[Shade tolerant morphotypes exist] "Recognizing the importance of C dynamics in the growth and survival of plants (Martínez-Vilalta et al., 2016), in a context of climate change, it is essential to investigate the possible impacts of increasing or decreasing VPD and temperature on the allocation of C in tropical trees, especially in shade-tolerant and sun-tolerant plants, as they represent the largest global C drain (Grace et al., 2014). For this purpose, we used plants of two morphotypes of Paubrasilia echinata (Fabaceae), a native species of the Atlantic Forest biome from Brazil, as a research model. The species comprises three morphotypes (small leaf, medium leaf and large leaf) that diverge from each other in the morphology of its recomposed leaves and in the ecological habit. The small morphotype (SM) has smaller leaflets (Fig. 1). The medium morphotype (MM) and the large morphotype (LM) have leaflets with an intermediate and larger area, respectively (Juchum et al., 2008). In the initial growth phase, the first morphotype behaves as a shade-tolerant plant while the last two are sun-tolerant (Gama, 2017; Gama et al., 2019). This divergence in the habits of P. echinata morphotypes is unique in tropical forests, making this plant species an excellent object of ecophysiological studies applied to shade and sun plants by excluding the interspecific taxonomic divergence (Gama et al., 2017; Cuzzuol et al., 2020). Organisms with this intraspecific profile can provide better understanding of the morphological, physiological and biochemical responses of tropical plants of these two functional types under different microclimate conditions such as temperature increase, CO2 and UV-B, flooding, and drought expected for Brazilian tropical forests for the next 50 years (Cuzzuol et al., 2020)."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	**Notes**
	Mejía, E., & Buitrón, X. (2008). Brazilwood (Caesalpinia echinata) in Brazil. In NDF Workshop Case Studies, WG 1 – Trees, Case Study 5: 1-10	"Brazilwood is confined to the Atlantic Forest, an ecosystem recognized as a global biodiversity hotspot. It inhabits coastal regions with open forest and well-drained soils." ... "C. echinata chiefly occurs on coastal plains and lowlands, on sandy or sandy-clay soils. Its patchy distribution along the Atlantic coast reflects this preference (CITES 2007)."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Soil descriptors - Soil texture: light; medium - Soil drainage: free - Soil reaction: acid - Special soil tolerances: infertile"

Qsn #	Question	Answer
411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Medium sized to large trees, 5–15+ m tall"

412	Forms dense thickets	n
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	[No evidence] "Habitat. Dry coastal cactus scrub often on rocky outcrops, inland in Mata Atlântica, and in tall restinga on well-drained sandy soil."
	Furley, P. A. (2007). Tropical forests of the lowlands. The Physical Geography of South America. Oxford University Press, New York, 135-157	[No evidence] "The Mata Atlântica forms one of the world's major biological hotspots, with a remarkably high proportion of endemic organisms (Olson and Dinerstein, 1998; Biotropica, 2000)." ... "Over 100 plant species have endangered status (IUCN, 1986), including at least one important hardwood, Caesalpinia echinata (Mori, 1989)."

501	Aquatic	n
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	[Terrestrial] "Habitat. Dry coastal cactus scrub often on rocky outcrops, inland in Mata Atlântica, and in tall restinga on well-drained sandy soil."

502	Grass	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 4 May 2022]	"Family: Fabaceae (alt. Leguminosae) Subfamily: Caesalpinioideae Tribe: Caesalpinieae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Montagnini, F., Fanzeres, A., & Da Vinha, S. G. (1995). The Potentials of 20 Indigenous Tree Species for Soil Rehabilitation in the Atlantic Forest Region of Bahia, Brazil. Journal of Applied Ecology, 32(4), 841–856	"Caesalpinia echinata, (leguminous, non-N-fixing)"
	Sprent, J. I., & Parsons, R. (2000). Nitrogen fixation in legume and non-legume trees. Field Crops Research, 65(2-3), 183-196	"Table 2 Examples of non-nodulated legumes used for timber" [Includes Caesalpinia echinata]

Qsn #	Question	Answer
504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Medium sized to large trees, 5–15+ m tall"

601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Over-harvested in native range] "The tree is a source of an important red/purple dye and is known as pau brasil, from which Brazil derived its name. Natural populations of the species were almost totally exterminated, as a result of centuries of over-exploitation. It is now considered an endangered species, being restricted to a few remaining areas in Rio de Janeiro, Bahia, Pernambuco, Espirito Santo, and possibly Alagoas and Rio Grande de Norte (historical records require confirmation in these two states)."

602	**Produces viable seed**	**y**
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Flowering occurred mainly in the dry season and the peak of seed dispersal was at the beginning of the wet season." ... "Natural fruit set was low (9.2%) with mature fruits averaging 1.7±0.9 seeds."
	Plants for a Future. (2022). Caesalpinia echinata. https://pfaf.org. [Accessed 4 May 2022]	"Propagation - Seed - pre-soak for 12 - 24 hours in warm water prior to sowing. Sow the seed in a partially shaded position in individual containers. A germination rate in excess of 60% can be expected, with the seed sprouting within 8 - 15 days[419]. When the seedlings are 4 - 6cm tall, pot them up into individual containers and they should be ready to plant out 4 - 5 months later[419]. Seeds must be sown fresh, they fail to germinate after storage for 30 days[349]. Softwood cuttings in sand in a frame[200]. This plant may be considered a protected species; check before digging or gathering seeds."

Qsn #	Question	Answer
	Barbedo, C. J., Billa, D. A., & Figueiredo-Ribeiro, R. D. C. L. (2002). Tolerância à dessecação e armazenamento de sementes de Caesalpinia echinata Lam.(pau-brasil), espécie da Mata Atlântica. Brazilian Journal of Botany, 25 (4), 431-439	"The exploitation of Caesalpinia echinata reduced markedly the original geographic distribution of the species. The knowledge of seed physiology, mainly desiccation tolerance and storability, could be helpful for the conservation of the species and future recovery of degraded areas of the Atlantic Forest. Desiccation study was performed in four categories of seeds selected according to colour and size (I, II, III, and IV stages), being submitted to drying at 40 ºC and 50 ºC until 8% water content was reached. Freshly harvested and dried (9.7%) seeds were stored in cold chamber (7 ± 1 ºC) or in natural environment (22 ± 7 ºC) using packages with three different levels of permeability. Results showed that seeds of C. echinata are tolerant to desiccation (until 7.6% wet basis) and seed sensitivity to drying is dependent on the initial quality of the seed. Seeds stored in natural environment lost their viability in three months while under low temperatures germination was 80% after 18 months."

603	Hybridizes naturally	n
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	[No evidence. Monospecific] "Geographic distribution. A monospecific genus endemic to Eastern Brazil, in the states of Pernambuco, Bahia, Espirito Santo and Rio de Janeiro. Widely cultivated in Brazil as an ornamental street or park tree, and sometimes in plantations."

604	Self-compatible or apomictic	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Results of the controlled pollinations and analysis of pollen tube growth revealed C. echinata presents late-acting self-incompatibility. The pollination biology and breeding system of C. echinata are discussed, together with available data on its genetics and physiology, in terms of best conservation practice for this endangered species. Data on the reproductive biology of the genus are scarce, revealing the predominance of bee pollination and SI system, with the occurrence of late-acting self-incompatibility mechanisms in some species." ... "The absence of fruit set after hand self-pollinations indicates that C. echinata is self-incompatible (ISI ¼ 0) and depends on pollinators to set fruits."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"The flowers are zygomorphic, yellow, sweet-scented, and the effective pollinators were mainly medium-sized to large bees of the genera Centris and Xylocopa, together with the introduced Apis mellifera."

606	Reproduction by vegetative fragmentation	

Qsn #	Question	Answer
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Ability to sucker" [No other information on suckering found]
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other." [No evidence. Reproduces by seed]
	Tropical Plants Database, Ken Fern. (2022). Paubrasilia echinata. http://tropical.theferns.info. [Accessed 5 May 2022]	[No evidence] "Propagation. Seed - pre-soak for 12 - 24 hours in warm water prior to sowing. Sow the seed in a partially shaded position in individual containers. A germination rate in excess of 60% can be expected, with the seed sprouting within 8 - 15 days[419]. When the seedlings are 4 - 6cm tall, pot them up into individual containers and they should be ready to plant out 4 - 5 months later [419]. Seeds must be sown fresh, they fail to germinate after storage for 30 days[349]. Softwood cuttings in sand in a frame[200]."
	WRA Specialist. (2022). Personal Communication	May be able to spread by suckering, but evidence is minimal.

607	**Minimum generative time (years)**	**3**
	Source(s)	**Notes**
	BioParque. (2022). Pau Brasil (Redwood) Caesalpinia echinata. https://www.bioparquebrasil.com.br/en/arvores/pau-brasil/. [Accessed 4 May 2022]	"Growth - Moderate: 1.0 meter per year" ... "Adult - 5 to 7 years"
	Mejía, E., & Buitrón, X. (2008). Brazilwood (Caesalpinia echinata) in Brazil. In NDF Workshop Case Studies, WG 1 – Trees, Case Study 5: 1-10	"Its growth rate is slow and depends on several factors such as soil type, climate, and geographic location (Mello 2008)."
	Plants for a Future. (2022). Caesalpinia echinata. https://pfaf.org. [Accessed 5 May 2022]	"Plants begin to flower when around 3 - 4 years of age"

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**n**
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other."
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Fruit a spiny, finely pubescent, sub-lunate, woody,5.5–7.3 × 1.9–2.6 cm, elastically dehiscent pod with twisting valves, 1–2-seeded. Seeds laterally compressed, ovate-obovate." [No means of external attachment]

702	**Propagules dispersed intentionally by people**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"C. echinata is widely cultivated and used in landscape design and urban arborization because of its ornamental appearance."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other." [No evidence. Unlikely. A large tree with relatively large seeds]

704	Propagules adapted to wind dispersal	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other." [Wind may facilitate some short distance dispersal of seeds, but this species lacks morphological adaptations for wind dispersal]

705	Propagules water dispersed	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other." [No evidence]
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Habitat. Dry coastal cactus scrub often on rocky outcrops, inland in Mata Atlântica, and in tall restinga on well-drained sandy soil." [No evidence. Not distributed near aquatic or riparian habitats]

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other."

707	Propagules dispersed by other animals (externally)	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other."

708	Propagules survive passage through the gut	n
	Source(s)	**Notes**
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Autochoric seed dispersal (explosive) occurred along the rainy season." ... "Additionally, the autochorous dispersal mechanism of the species promotes a clustered distribution with related individuals close to each other." [No evidence of zoochory]

801	Prolific seed production (>1000/m2)	n
	Source(s)	**Notes**
	Gagnon, E., Bruneau, A., Hughes, C. E., de Queiroz, L. P., & Lewis, G. P. (2016). A new generic system for the pantropical Caesalpinia group (Leguminosae). PhytoKeys, (71): 1-160	"Medium sized to large trees, 5–15+ m tall" ... "Fruit a spiny, finely pubescent, sub-lunate, woody, 5.5–7.3 × 1.9–2.6 cm, elastically dehiscent pod with twisting valves, 1–2-seeded." [In spite of tree size, few-seeded fruit unlikely to reach densities >1000/m2]
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	"Natural fruit set was low (9.2%) with mature fruits averaging 1.7 ± 0.9 seeds.:

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Seed storage recalcitrant"
	Barbedo, C. J., Billa, D. A., & Figueiredo-Ribeiro, R. D. C. L. (2002). Tolerância à dessecação e armazenamento de sementes de Caesalpinia echinata Lam.(pau-brasil), espécie da Mata Atlântica. Brazilian Journal of Botany, 25 (4), 431-439	"Seeds stored in natural environment lost their viability in three months while under low temperatures germination was 80% after 18 months."

Qsn #	Question	Answer
803	**Well controlled by herbicides**	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	Unknown. No information found on herbicide efficacy or chemical control efforts for this species

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	
	Source(s)	**Notes**
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Ability to sucker" [Unknown. No information on coppicing or impacts of fire]
	Borges, L. A., Sobrinho, M. S., & Lopes, A. V. (2009). Phenology, pollination, and breeding system of the threatened tree Caesalpinia echinata Lam.(Fabaceae), and a review of studies on the reproductive biology in the genus. Flora-Morphology, Distribution, Functional Ecology of Plants, 204(2), 111-130	Unknown. No evidence

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Grows and could spread in regions with tropical climates
• Armed with prickles on branches and spiny fruit
• May be allelopathic
• Wood dust may be harmful
• Shade-tolerant
• Reproduces by seeds
• May be able to spread vegetatively through suckering (limited evidence)
• May reach maturity in 3+ years
• Seeds dispersed autochorously (explosively) and through intentional cultivation

Low Risk Traits
• No reports of naturalization or invasiveness worldwide
• Self-incompatible
• Relatively large seeds lack means for long-distance dispersal