Taxon: Chrysophyllum cainito L. **Family:** Sapotaceae

Common Name(s): caimito
star apple

Synonym(s): Cainito pomiferum Tussac
Chrysophyllum bicolor Poir.
Chrysophyllum caeruleum Jacq.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 23 Feb 2017

WRA Score: 2.0 **Designation:** L **Rating:** Low Risk

Keywords: Tropical Tree, Widely Naturalized, Edible Fruit, Self-Fertile, Zoochorous

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	n
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	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	n
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	y=1, n=0	n
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	n

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	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	>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		
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	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	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Parker, I., López, I., Petersen, J., Anaya, N., Cubilla-Rios, L., & Potter, D. (2010). Domestication Syndrome in Caimito (Chrysophyllum cainito L.): Fruit and Seed Characteristics. Economic Botany, 64(2), 161-175	[Cultivated plants exhibiting domesticated traits such as larger fruit and more pulp, but not highly domesticated] "The process of domestication is understudied and poorly known for many tropical fruit tree crops. The star apple or caimito tree (Chrysophyllum cainito L., Sapotaceae) is cultivated throughout the New World tropics for its edible fruits. We studied this species in central Panama, where it grows wild in tropical moist forests and is also commonly cultivated in backyard gardens. Using fruits collected over two harvest seasons, we tested the hypothesis that cultivated individuals of C. cainito show distinctive fruit and seed characteristics associated with domestication relative to wild types. We found that cultivated fruits were significantly and substantially larger and allocated more to pulp and less to exocarp than wild fruits. The pulp of cultivated fruits was less acidic; also, the pulp had lower concentrations of phenolics and higher concentrations of sugar. The seeds were larger and more numerous and were less defended with phenolics in cultivated than in wild fruits. Discriminant Analysis showed that, among the many significant differences, fruit size and sugar concentration drove the great majority of the variance distinguishing wild from cultivated classes. Variance of pulp phenolics among individuals was significantly higher among wild trees than among cultivated trees, while variance of fruit mass and seed number was significantly higher among cultivated trees. Most traits showed strong correlations between years. Overall, we found a clear signature of a domestication syndrome in the fruits of cultivated caimito in Panama."

102	Has the species become naturalized where grown?	
	Source(s)	**Notes**
	WRA Specialist. 2017. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	**Notes**
	WRA Specialist. 2017. Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 22 Feb 2017]	"Native: Southern America Caribbean: Cayman Islands; Cuba; Dominican Republic; Haiti; Jamaica; Puerto Rico"

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 22 Feb 2017]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Starapple is tropical in its requirements and prefers a warm, humid atmosphere with relatively high temperatures throughout the year. Mature trees are damaged by frosts while young trees are killed by frosts." ... "Throughout its native range and in southeast Asia, it thrives in the lowlands (up to 400 m elevation) and in areas with a distinct dry season but can grow up to an altitude of 1,000 m."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Starapple is probably native to the Greater Antilles in the Caribbean. It is widely cultivated in tropical Central, South America and the Caribbean – Cayman Islands, Cuba, Dominican Republic, Haiti, Jamaica and Puerto Rico."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Starapple is probably native to the Greater Antilles in the Caribbean. It is widely cultivated in tropical Central, South America and the Caribbean – Cayman Islands, Cuba, Dominican Republic, Haiti, Jamaica and Puerto Rico. Now it is also cultivated throughout the tropics and subtropics in Florida, Taiwan, India, Thailand, the Philippines, Vietnam, Malaysia, Indonesia and Northern Australia."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Star-apple reached Hawaii before 1901 and is grown here both for its edible fruits and, to a lesser extent, for its dramatic ornamental foliage."

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 22 Feb 2017]	"Naturalized: . widely natzd. in tropics"
	Woodson, R., Schery, R., & Blackwell, W. (1968). Flora of Panama. Part VIII. Family 154. Sapotaceae. Annals of the Missouri Botanical Garden, 55(2), 145-169	"Probably native to the West Indies; cultivated and often naturalized in Central America and Mexico and occasionally in northern South America and southern Florida."

Qsn #	Question	Answer
	Tassin, J., Riviere, J.-N., Cazanove, M. & Bruzzese, E. 2006. Ranking of invasive woody plant species for management on Reunion Island. Weed Research, 46(5): 388-403	"Table 1 Woody non-indigenous plants to Reunion Island and their invasive status" [Chrysophyllum cainito - , known as a coloniser in Reunion Island]
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Today it Is naturalized in Central America, elsewhere in the Caribbean, and in many places where it has escaped cultivation."
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. 2017. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/. [Accessed 22 Feb 2017]	No evidence to date in the Hawaiian Islands

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	Included in some references of weeds, but no evidence of negative impacts
	CABI, 2017. 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

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

305	Congeneric weed	y
	Source(s)	**Notes**
	Oppenheimer, Hank L. 2003. New plant records from Maui and Hawai'i Counties. Bishop Museum Occasional Papers. 73: 3-30	[Chrysophyllum oliviforme naturalized and targeted for eradication] "Satinleaf was first documented as a naturalized species in Hawai'i by Lorence et al. (1995: 54); they cited collections made on Kaua'i. Wagner et al. (1997: 62) later reported it from the islands of O'ahu and Hawai'i. On West Maui, it was planted in the 1920s on Maui Pineapple Co. lands as part of Maunalei Arboretum (Maui Pineapple Co., unpubl.). In recent years numerous seedlings have been observed amongst the plantings, and mature, fruiting trees with thousands of seedlings and saplings have been found in two widely separated locations over 400 m away. It is believed that feral pigs have dispersed the fruits. Efforts are already underway to eradicate all known plants, as well as the animals. On East Maui, C. oliviforme is known from several sites, including Ha'ikü, Twin Falls, and Ke'anae."

Qsn #	Question	Answer
401	**Produces spines, thorns or burrs**	**n**
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	[No evidence] "An evergreen erect tree, 8–20 m tall, with a trunk of 60 cm diameter and dense, broad crown. Its trunk is usually straight, cylindrical, but often fluted or spurred at the base; buttresses are small or absent; bark surface is rough, irregularly fissured, brown and exude a white gummy latex. Young twigs are reddish-brown and pubescent. The leaves are alternate, elliptic or oblong-elliptic, 5–15 cm long, slightly leathery, rich green and glossy on the upper surface, and coated with persistent reddish-brown silky indumentum on the underside when mature imparting a golden-bronze colour to the underside (Plates 1 and 2), although they are silvery when young. Petioles are 0.6–1.7 cm long."

402	Allelopathic	
	Source(s)	**Notes**
	WRA Specialist. 2017. Personal Communication	Unknown. No evidence found

403	Parasitic	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"An evergreen erect tree, 8–20 m tall, with a trunk of 60 cm diameter and dense, broad crown." [Sapotaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	Van Bael, S. A., Aiello, A., Valderrama, A., Medianero, E., Samaniego, M., & Wright, S. J. (2004). General herbivore outbreak following an El Nino-related drought in a lowland Panamanian forest. Journal of Tropical Ecology, 20 (06), 625-633	"Table 1. Plant species and sampling effort for caterpillar censuses" [Chrysophyllum cainito palatable to caterpillars]
	WRA Specialist. 2017. Personal Communication	Unknown. Fruit pulp consumed by animals and people, but palatability of foliage to browsing animals unknown.

405	Toxic to animals	
	Source(s)	**Notes**
	Morton, J.F. 1987. Fruits of Warm Climates. J.F. Morton, Miami, FL	[Unknown if seeds are poisonous to animals] "Toxicity: The seeds contain 1.2% of the bitter, cyanogenic glycoside, lucumin; 0.0037% pouterin; 6.6% of a fixed oil; 0.19% saponin; 2.4% dextrose and 3.75% ash. The leaves possess an alkaloid, also resin, resinic acid, and a bitter substance."

406	Host for recognized pests and pathogens	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	"Diseases Fusarium solani may kill young trees and damage limbs of mature trees. The fruit may be attacked by a dry rot (Lasiodiplodia theobromae) prior to harvest and also by stem-end decay caused by Pestalotia sp. and Diplodia sp. According to Morton (1987) leaves may be attacked by Phomopsis sp., Phyllosticta sp. and algal leaf spot (Cephaleuros virescens). insects Insect pests include mealy bugs, chewing insects, carpenter moths, scales, twig borers and fruit flies. An unidentified webworm larva has been observed feeding on flowers (Crane, 2008). Larvae of small insects are found in many ripe fruit. Spider mites can also attack the foliage, especially when it is hot and dry. Birds can be very harmful to ripening fruit (Vargas et al., 1999) and bats may also cause damage to them."
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 22 Feb 2017]	"Insect pests include twig borers, carpenter moth, mealy bugs, scales and fruit flies. The oriental fruit fly Dacus dorsalis is a serious pest of ripening fruit and renders the fruit unfit for human consumption. Wrapping young fruit and collecting and destroying the infested fruit may reduce the damage. Birds, bats and wild cats can also cause considerable damage. The fungus Lasiodiplodia theobromae causes dry, sooty rot on fruits, which copper fungicides can controlled. In Queensland, Australia, Fusarium solani kills young trees and affects limbs of older trees. An unidentified fungal pathogen shrivels immature fruit in Florida."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"The trees have few pest problems."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Sweet fleshy ripe fruit mesocarp is edible and delicious. The ripe fruit is eaten fresh or preferably chilled, is cut in half and the flesh spooned out and eaten. It is also used as an ingredient of ice cream and sherbet. In Jamaica it is sometimes made into preserves. The skin and rind are not edible and has a bitter latex. An emulsion of the slightly bitter seed kernels is used to make an imitation of milk-of-almonds."
	Morton, J.F. 1987. Fruits of Warm Climates. J.F. Morton, Miami, FL	[Fruit pulp consumed. Seeds could be accidentally ingested, but are otherwise only used for propagation] "Toxicity: The seeds contain 1.2% of the bitter, cyanogenic glycoside, lucumin; 0.0037% pouterin; 6.6% of a fixed oil; 0.19% saponin; 2.4% dextrose and 3.75% ash. The leaves possess an alkaloid, also resin, resinic acid, and a bitter substance."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Medicinal uses] "Seeds tonic, diuretic and febrifuge. Ripe fruit used as a treatment for diabetes mellitus and as a decoction is gargled to relieve angina; unripe fruits eaten to overcome intestinal disturbances. Bark astringent, tonic and stimulant, taken to halt diarrhea, dysentery and hemorrhages, and as a treatment for gonorrhea and bladder catarrh. Decoction of leaves as a cancer remedy; leaves infusion febrifuge. Latex applied on abscesses and dried powdered form given in dysentery; dried latex diuretic, febrifuge and vermifuge."

Qsn #	Question	Answer
408	**Creates a fire hazard in natural ecosystems**	**n**
	Source(s)	**Notes**
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	[No evidence] "Star apple is a tropical tree that can grow in the warm subtropics. It prefers medium to high rainfall of 1,400 mm year-1 or more, but with an interruption by a defined dry period to ensure good flowering that occurs on the current season's growth. Excessive drought can defoliate the tree and reduce fruit size and appearance." ... "The tree prefers the hot humid tropics up to 425 m and a maximum of 1,000 m altitude and does not grow well when temperatures are cool, though it can withstand cool conditions."

409	**Is a shade tolerant plant at some stage of its life cycle**	**n**
	Source(s)	**Notes**
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	"The tree prefers to grow under full light."

410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y**
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"It grows on almost all types of soil from clayey loam, sand, or limestone and in a range of tropical and subtropical areas but does best in fertile, well-drained and slightly acid soils."
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	"Trees appear well adapted to a wide range of well-drained soil types (Barbeau, 1990) although they perform better in slightly acid soils. They can grow in clayey loams, sand and limestone but require good drainage."

411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"An evergreen erect tree, 8–20 m tall, with a trunk of 60 cm diameter and dense, broad crown."

Qsn #	Question	Answer
412	**Forms dense thickets**	**n**
	Source(s)	**Notes**
	Parker, I., López, I., Petersen, J., Anaya, N., Cubilla-Rios, L., & Potter, D. (2010). Domestication Syndrome in Caimito (Chrysophyllum cainito L.): Fruit and Seed Characteristics. Economic Botany, 64(2), 161-175	"In the wild, C. cainito is found at low density, does not produce fruit until the tree reaches the canopy of the forest, maintains few branches below 10 m, and produces ripe fruits over only a short time interval"
	Woodson, R., Schery, R., & Blackwell, W. (1968). Flora of Panama. Part VIII. Family 154. Sapotaceae. Annals of the Missouri Botanical Garden, 55(2), 145-169	"Probably native to the West Indies; cultivated and often naturalized in Central America and Mexico and occasionally in northern South America and southern Florida." [No evidence]
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 23 Feb 2017]	[No evidence] "C. cainito is tropical in its requirements and prefers a humid atmosphere with relatively high temperatures throughout the year. Throughout Southeast Asia it thrives in the lowlands and in areas with a distinct dry season."

501	Aquatic	n
	Source(s)	**Notes**
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 22 Feb 2017]	[Terrestrial] "C. cainito is tropical in its requirements and prefers a humid atmosphere with relatively high temperatures throughout the year. Throughout Southeast Asia it thrives in the lowlands and in areas with a distinct dry season."

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 22 Feb 2017]	Family: Sapotaceae Subfamily: Chrysophylloideae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 22 Feb 2017]	Family: Sapotaceae Subfamily: Chrysophylloideae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"An evergreen erect tree, 8–20 m tall, with a trunk of 60 cm diameter and dense, broad crown."

601	Evidence of substantial reproductive failure in native habitat	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	[No evidence. Widespread distribution] "The most probable origin of star apple is the West Indies, from where it was probably spread to Central America long ago. Some authors indicate that it originated in both areas (Barbeau, 1990). This species is found throughout the lowland tropics of Central America, especially the Pacific side of Guatemala, in the Caribbean, especially Haiti, the warmer parts of South America (e.g. Colombia, Ecuador, Venezuela, Bolivia, Brazil, northern Argentina and Peru), Mexico, South-east Asia (including Malaysia, Thailand, Vietnam, Cambodia and the Philippines), Africa, India and Sri Lanka. Star apple is grown on a small scale and/or harvested commercially throughout its distributed range."

602	Produces viable seed	y
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Starapple can be propagated by seed, air layering, or grafting."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Petersen, J. J., Parker, I. M., & Potter, D. (2012). Origins and close relatives of a semi-domesticated neotropical fruit tree: Chrysophyllum cainito (Sapotaceae). American Journal of Botany, 99(3), 585-604	[Unknown] "Chrysophyllum cainito and C. oliviforme have not been reported to hybridize, although some other possibly intermediate forms have been observed on Jamaica (J. Petersen and D. Potter, personal observation)."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	"Star apple flowers are hermaphroditic, pollinated by insects and are usually self-fertile."
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	"The flowers are hermaphroditic and usually self-fertile, although sometimes isolated trees are fruitless (Campbell, 1974)."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Inflorescences are axillary, ramiflorous or cauliflorous. Flowers are bisexual, fasciculate with 5–35 clustered, small and inconspicuous, yellowish-white flowers. Calyx is 5-lobed, lobes are ovate with obtuse to rounded apex and hairy within. Corolla is 5-lobed with ovate and glabrous lobes. Stamens 5 with deltoid fi laments and ovoid anthers. Ovary is ferruginous- villous, 7–10-locular; style glabrous with 7-10-lobed stigma."
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	"Star apple flowers are hermaphroditic, pollinated by insects and are usually self-fertile."

606	Reproduction by vegetative fragmentation	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	[No evidence of natural vegetative spread] "Star apples are normally propagated by seeds that remain viable for several months and will germinate 20–40 days after sowing (Barbeau, 1990)." ... "Asexual propagation can be done by using cuttings. Air layers have also been used and can take 4–7 months to root (Vargas et al., 1999). Trees may also be grafted or budded, normally onto star apple seedlings (Crane, 2008); in that case the grafted or budded trees can start producing as soon as a year after transplanting to the field, though normally 3–4 years. Grafting can be done using the cleft method and budding can be done with the patch or the Forkert method using buds without the petiole attached (Alix and Duarte, 1999). Veneer grafting is also effective (Campbell, 1974). An ornamental relative Chrysophyllum oliviforme (satin leaf or caimitillo) can also be used as a rootstock for slowing or stunting tree growth (Morton, 1987; Hoyos, 1989)."

607	Minimum generative time (years)	>3
	Source(s)	**Notes**
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 22 Feb 2017]	"C. cainito commences to bear fruit in its 3rd to 5th year and usually reaches its full production in its 6th to 7th year."
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	"Fruit production from seedlings takes 5-12 years and grafted trees 4 -5 years."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	[No evidence. Fruit & seeds relatively large & lack means of external attachment] "Fruit is an obovoid-globose or oblate berry, 5–10 cm in diameter, green (Plates 1 and 2) turning yellowish-green (Plate 3) or purplish-green or purple (Plate 4). Rind is thick, leathery, smooth surfaced, somewhat glossy, dull purple in some varieties, light green in others with white and soft, jellylike flesh and a gummy latex." ... "Normally there is 1 seed in each segment, but frequently several are aborted, leaving 3–5 in the fruit. Seeds 3–10, flattened obovoid, about 2 cm × 1 cm × 0.5 cm, purplish-black, with a chartaceous testa and an adaxial scar."

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"It is widely cultivated in tropical Central, South America and the Caribbean – Cayman Islands, Cuba, Dominican Republic, Haiti, Jamaica and Puerto Rico. Now it is also cultivated throughout the tropics and subtropics in Florida, Taiwan, India, Thailand, the Philippines, Vietnam, Malaysia, Indonesia and Northern Australia."

Qsn #	Question	Answer
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 22 Feb 2017]	"Ornamental: The foliage is bright blue-green above and coppery beneath, creating attractive contrast when stirred by the wind; for its ornamental value alone it merits cultivation. In Cuba, Jamaica and several other tropical American countries, C. cainito is a common garden tree."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Star-apple reached Hawaii before 1901 and is grown here both for its edible fruits and, to a lesser extent, for its dramatic ornamental foliage."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	**Notes**
	Woodson, R., Schery, R., & Blackwell, W. (1968). Flora of Panama. Part VIII. Family 154. Sapotaceae. Annals of the Missouri Botanical Garden, 55(2), 145-169	"Fruit 3-10 cm broad, subglobose, several-seeded; seeds oblique-obovate, flattened, 1-2.5 cm long, the scar lateral, extending nearly the length of the seed." [No evidence. Fruits & seeds relatively large & unlikely to be inadvertently dispersed]

704	Propagules adapted to wind dispersal	n
	Source(s)	**Notes**
	Lim, T.K. 2013. Edible Medicinal And Non-Medicinal Plants. Volume 6, Fruits. Springer, Dordrecht	"Fruit is an obovoid-globose or oblate berry, 5–10 cm in diameter, green (Plates 1 and 2) turning yellowish-green (Plate 3) or purplish-green or purple (Plate 4). Rind is thick, leathery, smooth surfaced, somewhat glossy, dull purple in some varieties, light green in others with white and soft, jellylike flesh and a gummy latex." ... "Normally there is 1 seed in each segment, but frequently several are aborted, leaving 3–5 in the fruit. Seeds 3–10, flattened obovoid, about 2 cm × 1 cm × 0.5 cm, purplish-black, with a chartaceous testa and an adaxial scar."

705	Propagules water dispersed	n
	Source(s)	**Notes**
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 23 Feb 2017]	"Fruit is commonly round, sometimes oblate, and 5-10 cm in diameter." ... "Seeds ovate to elliptic in outline, laterally compressed, 2 cm long, hard, brown and glossy with an adaxial scar." ... "Bats disperse the fruit."

706	Propagules bird dispersed	
	Source(s)	**Notes**
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 22 Feb 2017]	"Fruit is commonly round, sometimes oblate, and 5-10 cm in diameter." ... "Seeds ovate to elliptic in outline, laterally compressed, 2 cm long, hard, brown and glossy with an adaxial scar." ... "Bats disperse the fruit." [Birds may be too large for dispersal by birds present in the Hawaiian Islands]

707	Propagules dispersed by other animals (externally)	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 23 Feb 2017]	[Possibly carried by animals, but otherwise lack means of external attachment] "Fruit is commonly round, sometimes oblate, and 5-10 cm in diameter." ... "Seeds ovate to elliptic in outline, laterally compressed, 2 cm long, hard, brown and glossy with an adaxial scar." ... "Bats disperse the fruit."

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Kays, R. (1999). Food Preferences of Kinkajous (Potos flavus): A Frugivorous Carnivore. Journal of Mammalogy, 80(2), 589-599	"Fruits of Chrysophyllum and Astrocaryum occurred seasonally, as is typical of most species eaten by kinkajous, and were only available for a few months a year." [Pigs, rodents, and mongoose may consume fruit & disperse seeds in the Hawaiian Islands]

801	Prolific seed production (>1000/m2)	n
	Source(s)	**Notes**
	Woodson, R., Schery, R., & Blackwell, W. (1968). Flora of Panama. Part VIII. Family 154. Sapotaceae. Annals of the Missouri Botanical Garden, 55(2), 145-169	"Fruit 3-10 cm broad, subglobose, several-seeded; seeds oblique-obovate, flattened, 1-2.5 cm long, the s2ar lateral, extending nearly the length of the seed." [No evidence. Fruits & seeds relatively large]
	Ecocrop. 2007. Chrysophyllum cainito. http://ecocrop.fao.org/. [Accessed 23 Feb 2017]	"Mature trees can produce up to about 1000 fruits or more per season."
	Wright, S., Muller-Landau, H., Calderóon, O., & Hernandéz, A. (2005). Annual and Spatial Variation in Seedfall and Seedling Recruitment in a Neotropical Forest. Ecology, 86(4), 848-860	TABLE 2. Species, life forms, sample sizes, model selection criteria, relationship between recruit and seedfall density" ... "Numbers of seeds and recruits are summed over nine years and 200 0.5-m2 seed traps and 600 1-m2 seedling plots, respectively." [Chrysophyllum cainito seed density = 479 over a nine year period]

Qsn #	Question	Answer
802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**n**
	Source(s)	**Notes**
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 22 Feb 2017]	"Seed storage behaviour is intermediate, and seeds should not be dried before storage. Viability can be maintained for 6 months in moist storage at 20 deg. C.; 81% germination on desiccation to 4% mc (in equilibrium with 30% r.h.); 23% germination after 14 months of subsequent hermetic storage at 10 deg. C. for 1 seed lot. There are about 1100 seeds/kg."
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	"Seeds remain viable for several months and will germinate 14-40 days after sowing."
	Sautu, A., Baskin, J. M., Baskin, C. C., & Condit, R. 2006. Studies on the seed biology of 100 native species of trees in a seasonal moist tropical forest, Panama, Central America. Forest Ecology and Management, 234(1): 245-263	"Table 1 Results of germination and other studies of seeds of 100 species native to the Panama Canal watershed" [Chrysophyllum cainito - Longevity (months) = 8]
	Sautu, A., Baskin, J. M., Baskin, C. C., Deago, J., & Condit, R. (2007). Classification and ecological relationships of seed dormancy in a seasonal moist tropical forest, Panama, Central America. Seed Science Research, 17(2), 127–140	"Table 1. Class of seed dormancy for 94 species native to the Panama Canal" [Chrysophyllum cainito - Dormancy class = ND non-dormant]

803	**Well controlled by herbicides**	
	Source(s)	**Notes**
	WRA Specialist. 2017. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species, but herbicides used to control woody plants may be effective

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y**
	Source(s)	**Notes**
	Duarte, O., & Paull, R. (2015). Exotic fruits and nuts of the New World. CABI, Wallingford, UK	[Tolerates some pruning] "Young trees are not extensively trained other than allowing three to four main branches to form the major framework of the tree; this is achieved by topping the plants when they reach about 1 m height in the field and then leaving the best spatially distributed branches in the vertical and in the horizontal planes. Maintenance pruning includes eliminating damaged or diseased branches, branches growing too close to the ground and any branch growing in the wrong direction or into the canopy. Water sprouts should also be eliminated, especially during the early years when they tend to appear more abundantly. Mature trees may be pruned by hand or with machinery to limit tree size, since normally no more than 4 m in height should be allowed."

Qsn #	Question	Answer
805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"The trees have few pest problems."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Thrives in tropical climates
• Widely naturalized in the tropics (but no evidence to date in the Hawaiian Islands)
• Other Chrysophyllum species have become invasive
• Seeds reported to be toxic
• Tolerates many soil types
• Reproduces by seeds
• Self-fertile
• Seeds dispersed by animals (bats & ground-dwelling frugivorous mammals) & intentionally by people
• Tolerates pruning & resprouts after cutting

Low Risk Traits
• Unarmed (no spines, thorns, or burrs)
• Useful as a shade and fruit tree
• Prefers full sun (may limit ability to spread into intact forests)
• Not reported to spread vegetatively
• Reaches maturity in 3+ years
• Fruit and seeds relatively large, limiting ability for long distance dispersal

Second Screening Results for Tree/tree-like shrubs

(A) Shade tolerant or known to form dense stands?> No. Not known to form dense stands. A light demanding tree, & presumably shade intolerant
(B) Bird-dispersed?> Possibly, but relatively large fruit & seeds would limit birds capable of dispersing seeds
Outcome = Accept (Low Risk)